Vermont Flood Plain Management Services

Dam-Break Flood Analysis Weatherhead Hollow Pond Guilford, Vermont

December 1993

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New England Division

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Hydraulic and Water Resources Engineers, Inc.
1345 Main Street
Waltham, MA 02154

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13. ABSTRACT (Maximum 200 words)
The purpose of this study is to determine the downstream hazard potential of the Weatherhead Hollow Pond Dam in Guilford, Vermont. The work was completed for the Vermont Department of Environmental Conservation's Dam Safety Program. Various dam-break flood conditions were modeled and inundation maps developed. Based on this analysis the dam is rated a Class 2 or a significant hazard category in terms of its potential to cause downstream damage. Introductory information was also developed to aid in the development of an Emergency Action Plan in the event of an impending dam failure.

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WEATHERHEAD HOLLOW POND DAM
GUILFORD, VERMONT

DAM-BREAK FLOOD ANALYSIS

Prepared for

The U.S. Army Corps of Engineers
New England Division

and
State of Vermont
Department of Environmental Conservation
Dam Safety program

Prepared by:

Hydraulic and Water Resources Engineers, Inc.
Waltham, Ma 02154

December 1993

TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES

EXECUTIVE SUMMARY

The primary purpose of this study is to determine the downstream hazard potential of Weatherhead Hollow Pond Dam for the Dam Safety Program under the jurisdiction of the State of Vermont, Department of Environmental Conservation. The secondary purpose of the study is to provide introductory information for the dam owner to develop an Emergency Action Plan (EAP) in the event of an impending dam failure.

Dam-break flood conditions are evaluated for both sunny-day and storm-day failures. The analyzed storms are the 100-year storm and various fractions (1, ¾, ½ and ¼) of the probable maximum flood (PMF).

Inflow hydrographs and spillway rating curve were developed and used as a basis for modelling the breach discharge hydrographs using the HEC-1 Model and the National Weather Service DAMBRK Flood Forecasting Model. Breach discharge hydrographs for a sunny-day and storm-day are routed through the downstream channel for a distance of approximately 2.5 miles downstream from the dam. Maps of inundation caused by the floods are provided.

On the basis of the U.S. Army Corps of Engineers' guidelines for safety inspection, Weatherhead Hollow Pond Dam's size classification is SMALL. On the basis of its potential to cause downstream damage, in terms of either loss of life or economic loss, the dam is rated Class 2 or a SIGNIFICANT hazard category.

Four major components of the EAP are discussed: monitoring, evaluation, preventive action, and warning. The EAP also includes a current listing of officials to contact in the event of an impending dam failure.

A. DAM-BREAK FLOOD ANALYSIS

1. INTRODUCTION

a. Purposes

This report presents the findings of dam-break flood analyses performed for Weatherhead Hollow Pond Dam located in Guilford, Vermont. The dam is owned, operated and maintained by the Department of Fish and Wild Life of the State of Vermont. This study was not performed because of any known likelihood of a dam-break at Weatherhead Hollow Pond Dam, but rather to investigate the effect of a hypothetical dambreak. The report provides a description of pertinent features of the watershed, reservoir, dam, the analysis procedure, the assumed dam-break and overtopping conditions and the resulting effect on downstream flooded areas. The results of the analysis include:

- Downstream hydrographs due to dam-break floods.
- Flood discharges and timing for each dam-break scenario at all surveyed river sections.
- Inundation maps for the study river reach.

The report also provides a current listing of local and state officials to contact in the event of a dam failure.

b. Authority

The U.S. Army Corps of Engineers, New England Division authorized Hydraulic and Water Resources Engineers, Inc. of Waltham, Massachusetts to conduct this dam-break study for the Vermont Department of Environmental Conservation. The study was funded through the Corps of Engineers Section 206 Flood Plain Management Services (FPMS) Program.

c. Downstream Hazard Classification

Dams are classified according to their potential to cause loss of life and property damage in the area downstream of the dam if it were to fail. The hazard classification does not refer to the condition of the dam.

The classification system used in this study has been adopted by the U.S. Army Corps of Engineers and is used by the Vermont Department of Environmental Conservation to determine inspection frequency and spillway adequacy for dams under its jurisdiction. The categories and criteria for the hazard classification of dams, as reported in "Recommended Guidelines For Safety Inspection of Dams", Department of the Army, Sept. 1979 (Ref. 1), are listed in the following table.

DAM HAZARD CLASSIFICATION

Class	Potential Hazard Category	Loss of Life (Extent of Development)	Economic Loss (Extent of Development)
3	Low	None expected (No permanent structures for human habitation)	Minimal (Undeveloped to occasional structures or agriculture)
2	Significant	Few (No urban developments and no more than a small number of inhabitable structures)	Appreciable (Notable agriculture, industry or structures)
1	High	More than a few	Excessive (Extensive community, industry or agriculture)

2. PROJECT DESCRIPTION

a. General

Weatherhead Hollow Pond Dam is located in southeastern Vermont in the Town of Guilford, Vermont. The dam was constructed in 1965 for recreational purposes. It is an earth-fill dam approximately 340 feet in length and 18 feet in height. The principal spillway is a 24-inch concrete conduit with its inlet elevation at 661.0 feet NGVD (National Geodetic Vertical Datum). The emergency spillway consists of a concrete overfall 60 feet long; 4 feet high and 2 feet wide with its crest elevation at 674 feet NGVD. At normal pool level, the reservoir surface area is 22 acres. A plan view of the dam is shown in Plate 2.

b. Community Description

Weatherhead Hollow Pond surrounding community consists of rural area of dairy farming with little human settlement. About 50 % of the downstream flooded area affected by Weatherhead Hollow Pond Dam is in Massachusetts.

c. Downstream Conditions

The area under investigation for potential flooding is along Keets Brook and Shattuck Brook (Plate 1), and consists of primarily woodlands without low lying open areas. The flood plain is generally narrow with some flood storage potential in the wider valley sections. The limit of the study extends from the dam at Weatherhed Hollow Pond to about 2.28 miles downstream of the dam or approximately one mile downstream from the confluence of Keets Brook and Beaver Meadow Book.

The river channel starts at approximately 648.6 feet NGVD immediately downstream of the dam and drops to 489.7 feet NGVD at the downstream end of study reach. Along Keets Brook there are a few structures within proximity of the flood route.

3. DAM DESCRIPTION

a. Identification

Weatherhead Hollow Pond Dam is identified by the Vermont Department of Environmental Conservation as 90-2. The national inventory prepared by the U.S. Army Corps of Engineers identifies this dam as VT00116.

b. Physical Characteristics

Type:	Earth fill
Length:	340 ft.
Height:	18 ft.
Top Width:	Approximately 15 ft.
Side Slope:	Upstream face from 2.5:1 to 3.0:1 (Horizontal to Vertical). Downstream face from 2.5:1 to 3.0:1 (Horizontal to Vertical).

c. **Spillways**

Principal Spillway/Gatehouse:

- i) Type: 24 in. diameter drain pipe.
- ii) Hydraulic Capacity: 64 cfs. (computed with water surface at top of the dam)

Emergency Spillway:

- i) Type: 60 feet long, 4 feet high, 2 feet wide weir
- ii) Max. Hydraulic Capacity: 1609 cfs. (computed by HEC-1 with water surface at top of dam)

d. **Impoundment Behind Dam**

Surface Area:

i)	At principal spillway crest	33 acres
ii)	At top of dam	43 acres

Height of Dam:

i)	At principal spillway crest	13 feet
ii)	At top of dam	18 feet

Storage Volume (from Vermont State Dam Inventory):

i)	At principal spillway crest	145 ac-feet
ii)	At top of dam	320 ac-feet

e. **Dam Site Elevations**

i)	At top of dam	678.1 ft. NGVD
ii)	Emergency spillway/control section	674.1 ft. NGVD
iii)	Low drain pipe outlet	661.0 ft. NGVD
iii)	Streambed at downstream toe of dam	659.2 ft. NGVD

f. **Watershed Area**

- i) Size: 1 square mile
- ii) Type: Primarily woodland, steep slopes and minimal development

4. METHOD OF ANALYSIS

a. Introduction

This section discusses the methods and assumptions used in the dam-break analysis. Two types of dam failures were considered in this study: "sunny-day" and "storm-day" failures.

A sunny-day failure typically is a piping failure. Piping is internal erosion of the embankment through displacement of fines by seepage. The erosion creates voids in the embankment and, therefore, could lead to breach and eventually collapse of the dam.

A storm-day failure is associated with significant inflow into the impoundment. As a result of inadequate spillway capacity and reservoir storage capacity, overtopping of the embankment occurs. As the embankment is eroded, breach and ensuing failure develops.

b. Hydrology

To accommodate dam-break analysis, inflow hydrographs for the reservoir resulting from a 100-year storm and four fractions (1, ¾, ½, ¼) of probable maximum storm (PMS) were developed. Data necessary for generating the hydrographs include rainfall data and watershed characteristics.

The rainfall data for the 100-year storm were obtained from the National Weather Service's Rainfall Frequency Atlas of the United States Technical Paper 40 (Ref. 2) and HYDRO-35. To obtain a worst-case distribution, the rainfall data of 24-hour duration were critically arrayed such that the peak occured at the 12^{th} hour proceeded by the second largest rainfall increment and followed by the third largest.

The rainfall data, or probable maximum precipitation (PMP) data, for estimating the maximum probable storm (PMS) which yields the maximum probable flood (PMF) were obtained from Hydrometeorological Report No. 51 (HMR51) (Ref. 3). The 72-hour duration rainfall data from HMR51 were processed according to the guidelines provided in Hydrometeorlogical Report No. 52 (HMR52) to give an estimated 24-hour duration rainfall distribution of the PMS (Ref. 4). This 24-hour duration rainfall was comprised of the four greatest 6-hour incremental rainfalls from the 72-hour duration rainfall data. The resulting total rainfall of the PMS for a 24-hour duration was calculated to be 31.2 inches. Most of the work described here was done using the computer program BOSS HMR52.

The watershed model, HEC-1 (Ref. 5), was used to generate the inflow hydrographs resulting from the 100-year storm and the various fractions of PMS. Rainfall loss was calculated by employing SCS methodology which uses a single parameter, curve number. Based on the characteristics of the watershed, a composite curve number of 65 was adopted (Table 1). The SCS unit hydrograph method was utilized in computing the hydrographs. This method requires input of lag time. Based on the flow length and slope of the watershed, lag time was calculated as 0.31 hours.

c. **Reservoir Routing**

The inflow hydrographs were routed through the reservoir to obtain outflow flood hydrographs based on the area - capacity curve of the reservoir and the composite outflow rating curve. This study utilizes the HEC-1 model and the Boss Corporation's enhanced version of the National Weather Service's (NWS) DAMBRK flood forecasting computer model to develop peak water surface information for sunny-day and stormy-day failures. The HEC-1 model utilizes the Modified Puls Method of reservoir routing, which solves the continuity equation for incremental periods of time. The DAMBRK Model solves the complete unsteady flow equations (Ref. 6).

d. **Spillway Hydraulic Capacity**

A composite rating curve was developed based on the geometry of the spillway, dam and drain pipe. Flows over the spillway and over the top of dam were determined using the weir equation. The composite outflow rating curve was used in routing the inflow hydrographs through the pond.

e. **Breach Discharge Hydrographs**

The discharge hydrograph of a breach is a function of the inflow hydrograph and breach parameters of a hypothetical dam failure (Ref. 6). The sketch below illustrates the various dam breach parameters for a typical earth-fill dam. Total outflow from the reservoir is a combination of flows through the breach and the spillway. As the breach in the dam develops, so does the breach discharge.

f. **Assumed Dam-Breach Parameters**

Assumed Sunny-Day (Piping) Failure Condition:

i) Initial pool level: 674.1 feet NGVD

ii) Dam failure level (water surface that triggers beginning of breach): 674.1 feet NGVD

iii) Breach invert (top of low level outlet) el.: 668 feet NGVD

iv) Breach bottom width: 75 feet with side slopes 1.0V : 1.0H

v) Time to complete formation of breach: 1.0 hour

vi) Downstream reach roughness (Manning's n values):

0.040 to 0.060 for channel
0.045 to 0.060 for overbank

vii) Embankment geometry:

Height of dam = 18 feet
Crest length = 280 feet

Assumed Storm-Day (Overtopping) Failure Condition:

i) Initial pool level: 674.1 feet NGVD

ii) Dam failure level (water surface that triggers beginning of breach): 681.1 feet NGVD or 3.0 ft. above top of dam

iii) Breach invert el.: 659.1 feet NGVD

iv) Breach bottom width: 75 feet with side slopes 1.0V : 1.0H

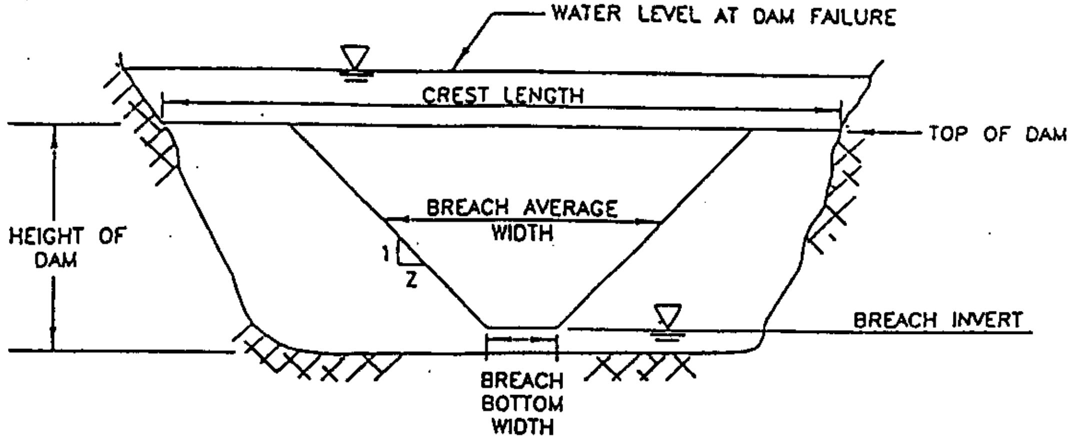
v) Time to complete formation of breach: 1 hour

vi) Downstream reach roughness (Manning's n values):

0.040 to 0.060 for channel
0.045 to 0.060 for overbank

vii) Embankment geometry:

Height of dam = 18 feet
Crest length = 280 feet



DEFINITION SKETCH OF BREACH PARAMETERS

g. Downstream Channel Routing

A downstream channel routing analysis allows the breach discharge hydrograph to be characterized at points of interest below the dam. Breach discharge hydrograph is attenuated and stored through a downstream channel and flood plain in a manner similar to that by which an inflow hydrograph is routed through the reservoir. The degree of the attenuation of this breach discharge hydrograph is a function of the downstream valley storage capacity and valley roughness characteristics.

(1) Method

The dynamic wave method of channel routing is used in DAMBRK to route the flood wave downstream. This is a hydraulic routing method that solves the complete equations of unsteady flow through a channel. Output from the computer code includes flood discharge, flood stage, and the time for the flood wave to reach a section.

(2) Typical Downstream Cross Sections

Cross sections of the study reach were obtained from field survey and USGS maps. Manning's "n" values were assigned to the channel and overbanks on the basis of field observations and standard reference material (Ref. 7).

(3) Downstream Flow Structures

The downstream channel routing procedure is based on the assumption that flow structures (i.e. culverts, bridges, etc.) below the dam do not become partially or fully blocked with debris. These structures are assumed to have full hydraulic capacity. If the structures become blocked with debris, the peak water surface behind could then increase to stages higher than estimated.

In addition, to estimate the maximum water level, all of the flow structures downstream of the dam were assumed not to fail in the dam-break computer model. However, because of the increased flood stages and velocities associated with a dam-break, failure of any or all of the flow structures is possible. This study does not attempt to predict if any downstream structure will fail during failure of Weatherhead Hollow Pond Dam.

(4) Antecedent Channel Flow

In order for the NWS DAMBRK model to mathematically converge, a minimum initial (antecedent) channel flow is required. For the sunny-day condition, assumed initial flow was 100 cfs, which is 2.5% of sunny-day dam-break peak discharge. Although relatively high for a drainage area of 1.0 square mile on a sunny day, this value is insignificant compared to breach discharge. For the adopted storm-day condition, the antecedent flow is the full PMF.

h. Project Mapping

The project mapping was developed by enlarging the USGS 1:25,000 Metric Quadrangle (7.5 x 15 minute) of Bernardston, Vermont. Locations of structures within the inundation limits were verified through field survey and site reconnaissance.

i. Vertical Control

Vertical Control for this investigation was obtained from a level loop on a standard U.S.G.S. disk stamped " TT 2 FI 694, 1942", painted "US 694.4 PBM". The disk is located in Guilford Center approximately 840 feet north of state line, or 90 feet north and 32 feet east from the road fork of Packer Corner Road and Brattleboro Road.

5. RESULTS OF THE ANALYSIS

a. Inflow Hydrograph

As shown in Table 2, the peak inflow resulting from the 100-year storm is 827 cfs and the full PMF peak inflow is about 7854 cfs. Figure 1 shows that the 100-year storm inflow hydrograph peaks at 13.0 hours into a 24-hour storm. Figure 2. shows that the full PMF inflow hydrograph peaks at 16.0 hours into a 24-hour storm. The full PMF inflow is very large because the 31.2 inch PMF is treated as a point rainfall for such a small watershed with the majority of this total occurring over a 1 hour time increment. This discharge was adopted as a conservative estimate of inflow for the dam-break simulation.

b. Reservoir Storage Capacity

The maximum storage capacity of the reservoir, i.e., storage at the top of the dam, is approximately 363 acre-feet. As determined from the full PMF inflow hydrograph analysis, 471 acre-feet of water is stored behind the dam at the maximum stage of 681.1 feet NGVD, 3.1 ft. above top of dam, for this storm event. This is due to an increase in water surface associated with the PMF occurring with the initial pool at the top of the spillway.

c. Spillway Hydraulic Capacity

The maximum spillway hydraulic capacity at the top of the dam is approximately 1600 cfs which includes flow from the drain pipe structure. As seen in Table 2, Weatherhead Hollow Pond Dam does appear to have adequate storage and spillway capacity to route and pass the 100-year and the ¼ PMF inflow hydrographs without overtopping the dam. The ½, ¾ and full PMF would, however, cause overtopping.

d. Breach Discharge Hydrograph

Tables 3 and 4 summarize the peak discharges and peak water surface elevations at critical stations along the downstream channel due to sunny-day and storm-day failures, respectively. Sunny-day failure resulted in a peak breach discharge of approximately 2314 cfs. The water surface was at an elevation of 674.1 feet NGVD when failure began, and the breach was assumed to develop fully within one hour. Plate 4A shows the sunny-day breach discharge hydrographs at downstream cross-sections.

Storm-day failure was based on the full PMF inflow hydrograph. As discussed earlier, the full PMF inflow resulted in a maximum reservoir stage of 681.1 feet NGVD (under the conditions without dam failure). The water surface was 3.0 feet above the dam. According to the outline in DAMBRK, it is therefore reasonable to use the full PMF inflow hydrograph as the input for the storm-day failure analysis. The breach was assumed to develop fully within one hour. The computation shows that the resulting peak breach discharge was 19100 cfs. Plate 4B shows the flow hydrographs at various downstream cross-sections.

e. Downstream Channel Routing

As shown in the breach discharge hydrographs (Plates 4A and 4B), flows are attenuated very little as they travel downstream. Plates 5A and 5B show the peak water surface elevations at downstream cross-sections for the two simulated floods, respectively. The flow conditions at each of these locations are described below.

(1) Sunny-Day Results

The peak discharge at the first downstream road crossing and habitable structure is 2,314 cfs. The maximum water level is 654.6 feet NGVD, 3.6 feet below the top of the road (El. 658.2 feet NGVD).

At the second road crossing and habitable structure, the discharge is about 2295 cfs. The resulting peak water surface elevation is 601.9 feet NGVD which is 20.9 feet below the surface of the road (El. 622.8 feet NGVD).

The peak discharge at the third road crossing is about 2295 cfs, and the resulting peak water surface elevation is 592.5 feet NGVD which is 25.3 feet below the top of the road (El. 617.8 feet NGVD).

The peak discharge at the last road crossing (limit of the study) is about 2268 cfs. The resulting peak water surface elevation is 498.6 feet NGVD which is 19.5 feet below the top of the road (El. 518.1 feet NGVD).

(2) Storm-Day Results

The peak discharge at the first downstream road crossing and habitable structure is about 19,100 cfs. The maximum water level is 665.0 feet NGVD which is approximately 6 feet above the top of the road.

At the second road crossing and habitable structure, the discharge is about

19,430 cfs. The resulting peak water surface elevation is about 619.2 feet NGVD which is 3.6 feet below the surface of the road.

The peak discharge at the third road crossing is about 19,430 cfs, and the resulting peak water surface elevation is about 603.2 feet NGVD which is 14.6 feet below the top of the road.

The peak discharge at the last road crossing is about 19,400 cfs. The resulting peak water surface elevation is about 510.2 feet NGVD which is 7.9 feet below the top of the road.

f. Inundation Mapping

The limits of inundation caused by the two hypothetical dam failure floods were defined by the boundaries of flow at the maximum stages along the downstream channel (Plates 3A and 3B). The flood resulting from the sunny-day failure is predicted to inundate three habitable structures downstream from the first road crossing, or about 0.5 mile downstream from the dam, and another habitable structure downstream from the second road crossing, or about 1.2 mile downstream from the dam. While the storm-day failure flood would inundate a total of six habitable structures at these two locations. It is, however, noted that some of these structures may not be subject to inundation because of possibly elevated foundation which might not be shown in the USGS map.

g. Size Classification

Weatherhead Hollow Pond Dam is 18 feet high at its maximum section. The maximum available storage behind the impoundment is 320 acre-feet. According to Article 2.1.1 of the "Recommended Guidelines for Safety Inspection of Dams", the dam size is **SMALL**.

h. Hazard Classification

As discussed earlier, the flood due to a sunny-day failure could inundate four habitable structures downstream from the dam while the flood due to a storm-day (PMF) failure would inundate six. The flood due to a storm-day failure is also predicted to overtop the first downstream road crossing. Both floods may also cause streambank erosion. On the basis of its potential to cause downstream damage, in terms of either loss of life or economic loss, Weatherhead Hollow Pond Dam is rated Class **2** or a **SIGNIFICANT** hazard category.

Table 1. Worksheet for computing CSC curve number (CN) and lag time (TLAG)

Soil Name	Hydrologic Group (TR55)	Cover Description (Cover Type, Treatment, and Hydrologic Condition, Percent Impervious unconnected/connected impervious area ratio)	Curve Number Table 2-2 (TR55)	Curve Number Fig 2-3 (TR55)	Curve Number Fig 2-4 (TR55)	Area % of Total Area	Product of CN * area
Tunbridge-Marlow-Lyman	A	Very Deep to Shallow, gently sloping to very steep. Soemwhat excessively Drained and well drained soil,Loam glacial till on hills.	65			0.5	32.5
Dummerston-Macomber-TACONIC	A	Very Deep to Shallow, gently sloping to very steep. Soemwhat excessively Drained and well drained soil,Loam glacial till on hills.	65			0.5	32.5
					Total	1	65

Cn (Weight)= $\frac{\text{Total product}}{\text{Total area}}$ = 65

Lag Time:
1. Hydraulic Length of the watershed 3080 ft
2. S= 1000/CN-10 5.38
3. Average Slope 15 %

Tlag= 0.31 hr

TABLE 2
RESERVOIR ROUTING SUMMARY
(HEC-1 Model Results)

Flood Frequency	**Drainage Area (acres)**	**Peak Inflow (cfs)**	**Peak* Outflow (cfs)**	**Max. Rese. Water Level (ft. NGVD)**	**Available** Freeboard (ft)**
100-year	620	827	136	674.6	3.48
1/4 PMF	620	1963	1609	677.8	0.32
1/2 PMF	620	3927	3525	679.4	Overtopped
3/4 PMF	620	5890	5590	680.4	Overtopped
1 PMF	620	7854	7546	681.2	Overtopped

* Discharge computed by HEC-1 with non failure run.
** Measured from maximum reservoir water level to elevation 678.07 feet NGVD.

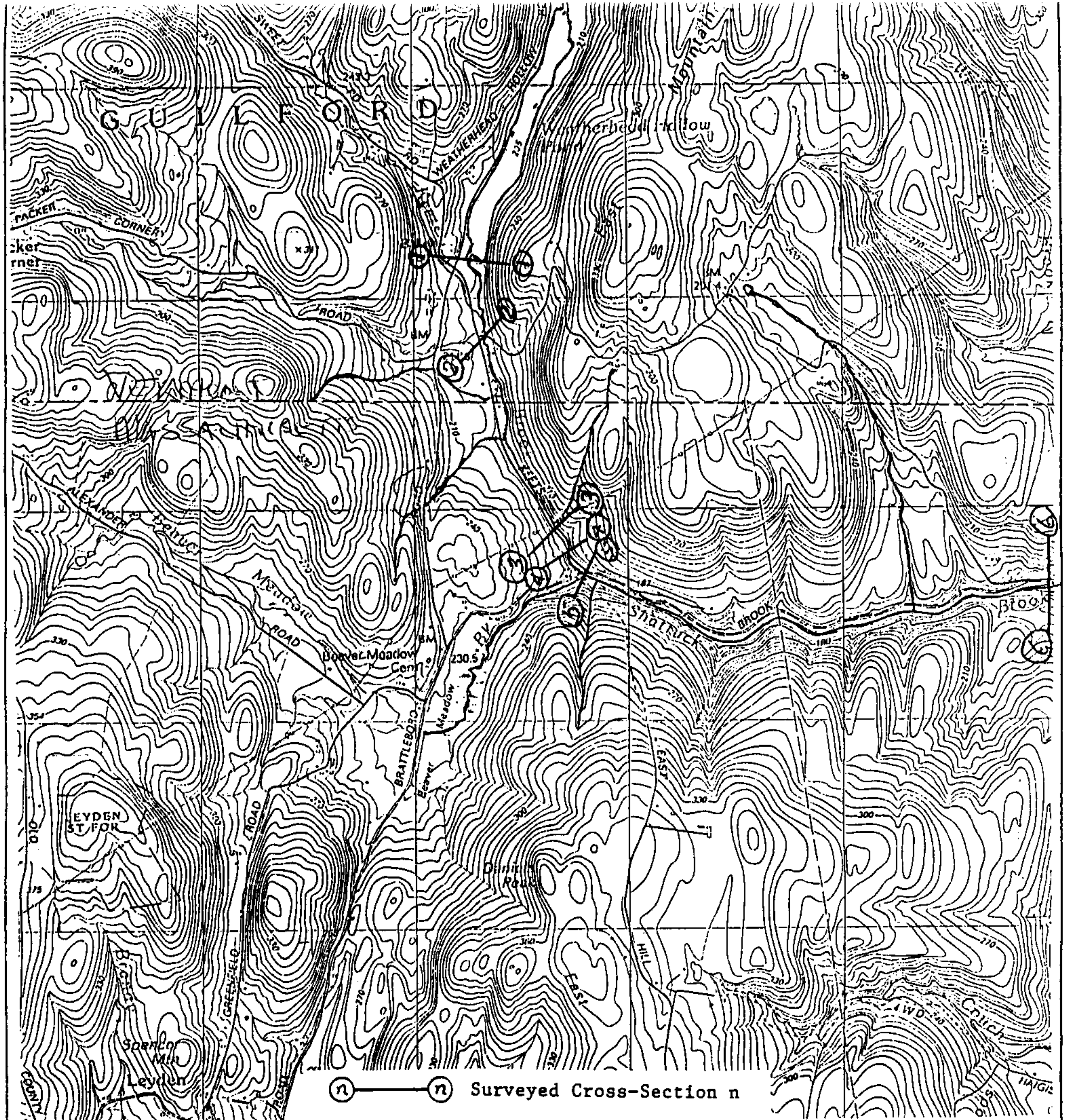
TABLE 3
DOWNSTREAM CHANNEL ROUTING RESULTS
Sunny-Day Failure

Downstream Location	Peak Discharge (cfs)	Peak Stage (ft NGVD)	Depth Above Streambed (ft)	Time to Peak Stage After Breach (hours)
Weatherhead Hollow Pond Dam (at 0.0 mi.)	2314	674.1	15.0	0.1
1st Road Crossing (at 0.28 mi.)	2314	654.6	6.0	1.0
2nd Road Crossing (at 1.12 mi.)	2295	601.9	7.8	1.05
3rd Road Crossing (at 1.22 mi.)	2295	592.0	7.0	1.05
4th Road Crossing (at 2.28 mi.)	2268	498.6	8.9	1.2

TABLE 4
DOWNSTREAM CHANNEL ROUTING RESULTS
Storm-Day Failure

Downstream Location	Peak Discharge (cfs)	Peak Stage (ft NGVD)	Depth Above Streamed (ft)	Time to Peak Stage After Start of Storm (hours)	Time to Peak Stage After Start of Breach (hours)
Weatherhead Hollow Pond Dam (at 0.0 mi.)	19,100	681.2	22.0	16.1	0
1st Road Crossing (at 0.28 mi.)	19,100	665.0	16.4	17.3	1.2
2nd Road Crossing (at 1.12 mi.)	19,430*	619.2	25.1	17.5	1.4
3rd Road Crossing (at 1.22 mi.)	19,430	603.2	18.2	17.5	1.4
4th Road Crossing (at 2.28 mi.)	19,420	510.2	20.5	17.6	1.5

*Includes lateral inflow



MAP BASED ON U.S.G.S

QUAD. 40-C CORPS A-8

VT 7420 - 10 - 003

SCALE: 1 : 25,000

HYDRAULIC & WATER RESOURCES ENGRS, INC.
CONSULTING ENGRS.
WALTHAM, MA 02154

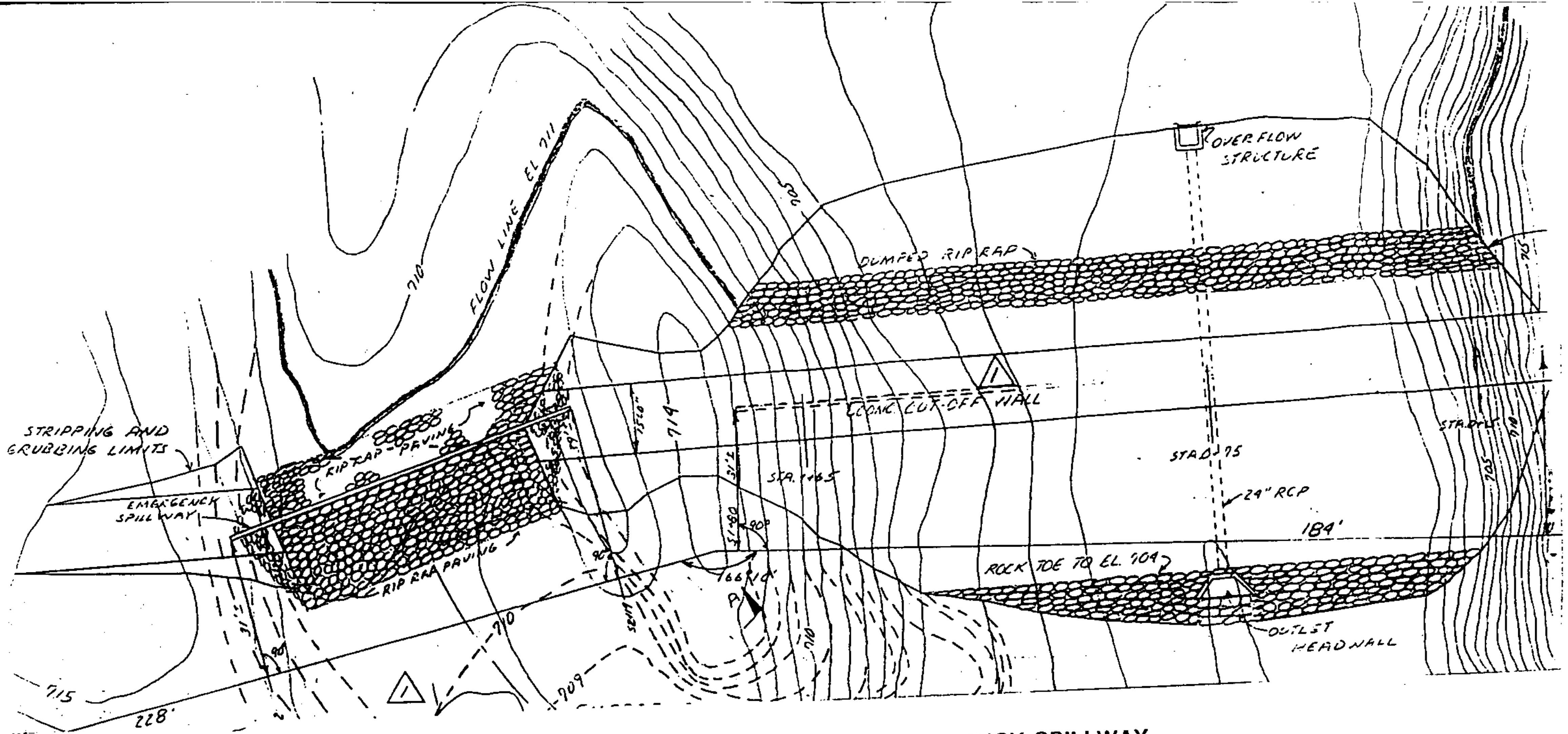
DEPT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MA 02154

WEATHERHEAD HOLLOW POND DAM

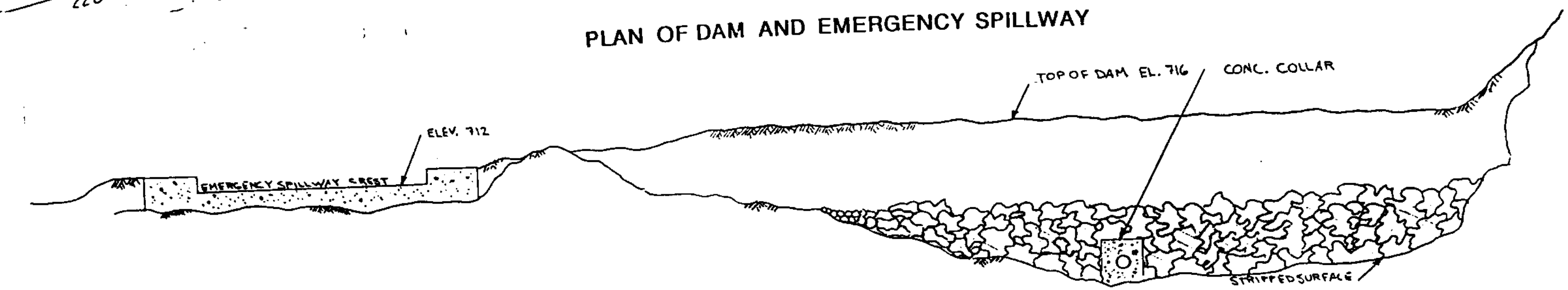
DAM BREAK ANALYSIS

INDEX MAP

PLATE No. 1



PLAN OF DAM AND EMERGENCY SPILLWAY



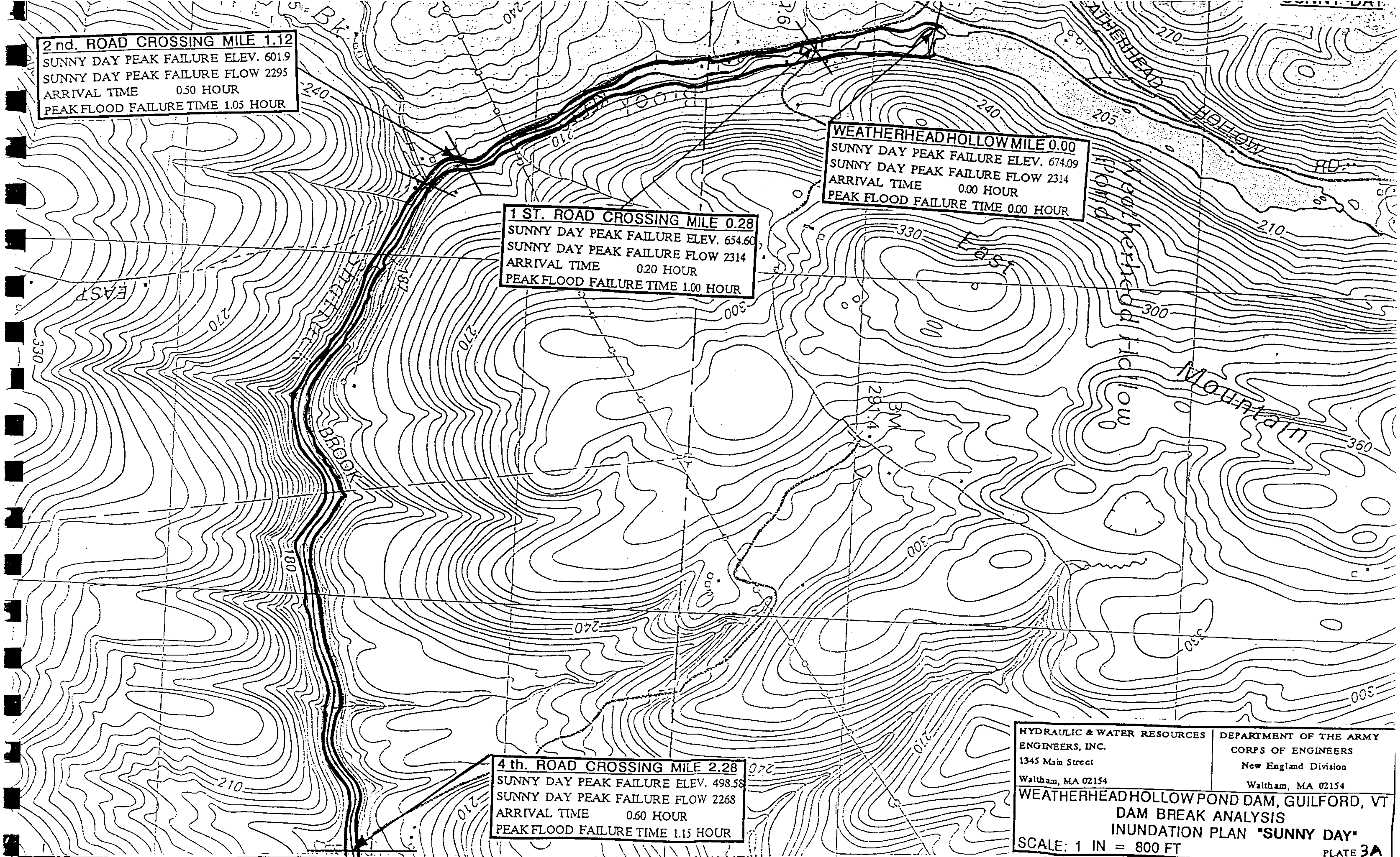
DATUM = NGVD + 37.9

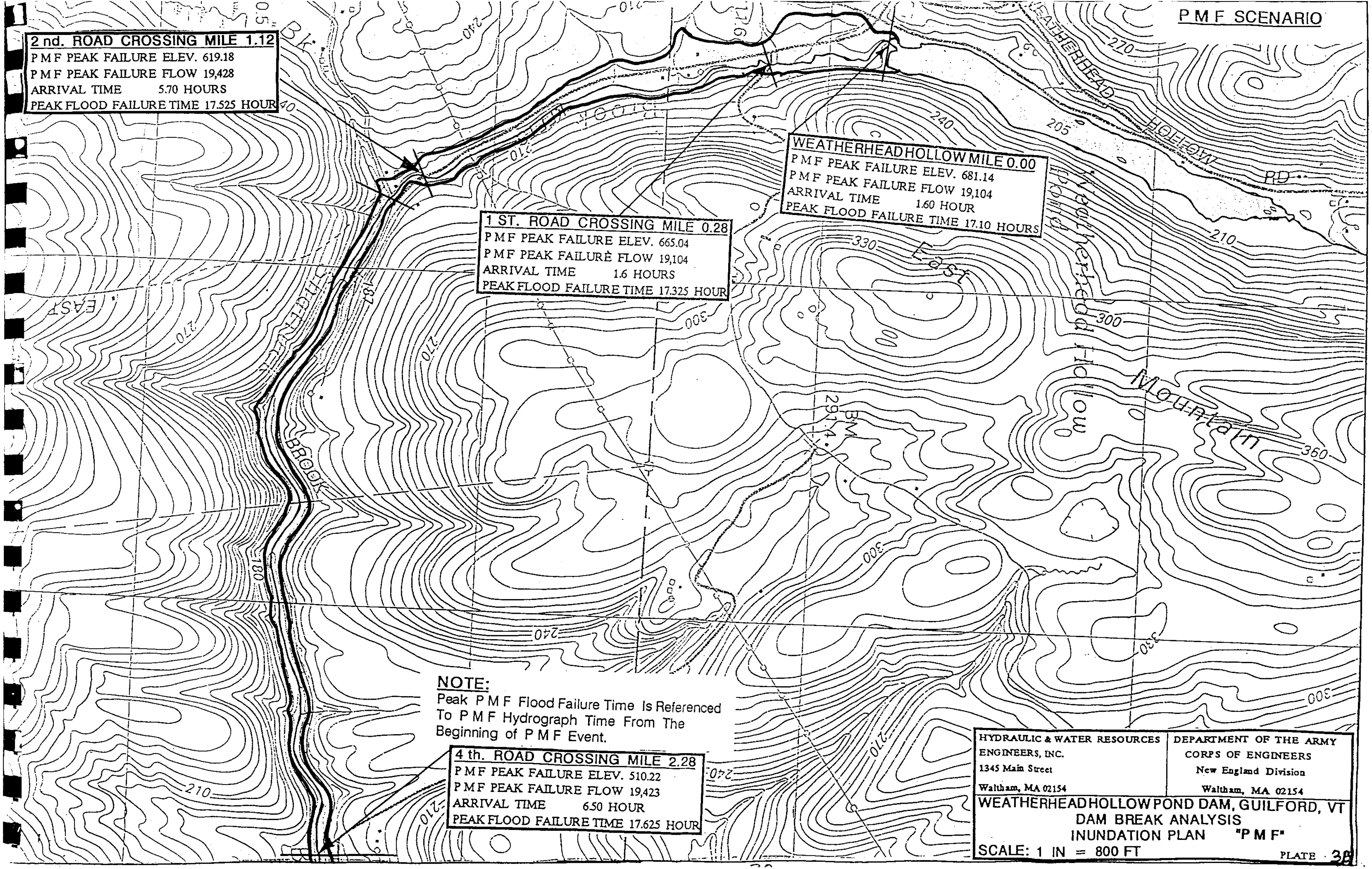
PROFILE OF DAM CENTERLINE
AND
EMERGENCY SPILLWAY

N.T.S

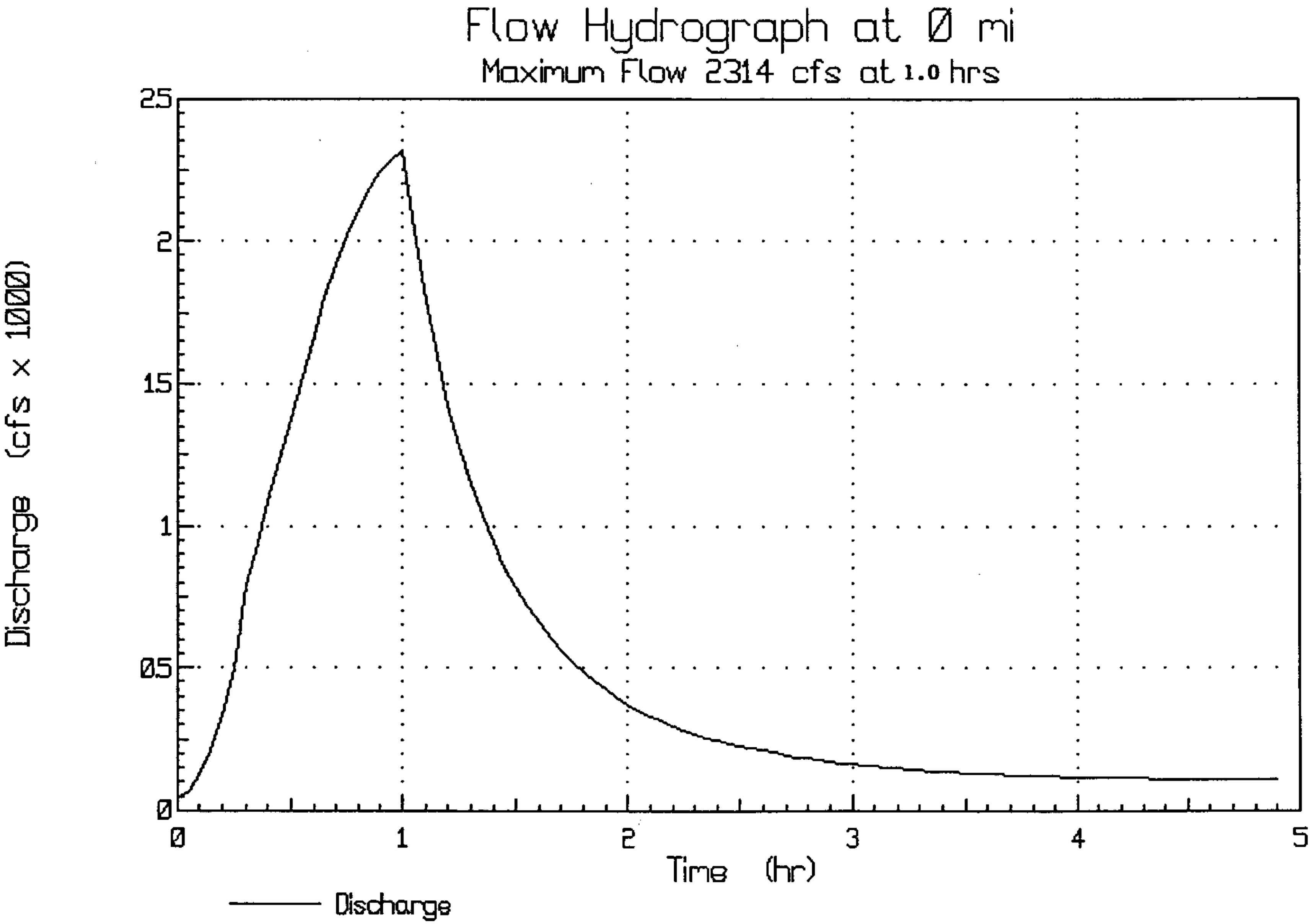
STATE OF VERMONT
WEATHERHEAD HOLLOW POND DAM
SITE PLAN

Plate No. 2


2 nd. ROAD CROSSING MILE 1.12
SUNNY DAY PEAK FAILURE ELEV. 601.9
SUNNY DAY PEAK FAILURE FLOW 2295
ARRIVAL TIME 0.50 HOUR
PEAK FLOOD FAILURE TIME 1.05 HOUR
WEATHERHEAD HOLLOW MILE 0.00
SUNNY DAY PEAK FAILURE ELEV. 674.09
SUNNY DAY PEAK FAILURE FLOW 2314
ARRIVAL TIME 0.00 HOUR
PEAK FLOOD FAILURE TIME 0.00 HOUR
1 ST. ROAD CROSSING MILE 0.28
SUNNY DAY PEAK FAILURE ELEV. 654.60
SUNNY DAY PEAK FAILURE FLOW 2314
ARRIVAL TIME 0.20 HOUR
PEAK FLOOD FAILURE TIME 1.00 HOUR
4 th. ROAD CROSSING MILE 2.28
SUNNY DAY PEAK FAILURE ELEV. 498.58
SUNNY DAY PEAK FAILURE FLOW 2268
ARRIVAL TIME 0.60 HOUR
PEAK FLOOD FAILURE TIME 1.15 HOUR
East Mountain
Weatherhead Hollow Pond
WEATHERHEAD HOLLOW RD
BROOK
HYDRAULIC & WATER RESOURCES ENGINEERS, INC.
1345 Main Street
Waltham, MA 02154
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
New England Division
Waltham, MA 02154
WEATHERHEAD HOLLOW POND DAM, GUILFORD, VT
DAM BREAK ANALYSIS
INUNDATION PLAN "SUNNY DAY"
SCALE: 1 IN = 800 FT
PLATE 3A



P M F SCENARIO
2 nd. ROAD CROSSING MILE 1.12
P M F PEAK FAILURE ELEV. 619.18
P M F PEAK FAILURE FLOW 19,428
ARRIVAL TIME 5.70 HOURS
PEAK FLOOD FAILURE TIME 17.525 HOUR
WEATHERHEAD HOLLOW MILE 0.00
P M F PEAK FAILURE ELEV. 681.14
P M F PEAK FAILURE FLOW 19,104
ARRIVAL TIME 1.60 HOUR
PEAK FLOOD FAILURE TIME 17.10 HOURS
1 ST. ROAD CROSSING MILE 0.28
P M F PEAK FAILURE ELEV. 665.04
P M F PEAK FAILURE FLOW 19,104
ARRIVAL TIME 1.6 HOURS
PEAK FLOOD FAILURE TIME 17.325 HOUR
WEATHERHEAD HOLLOW RD
Weatherhead Hollow
East Mountain
BROOK
EAST
NOTE:
Peak P M F Flood Failure Time Is Referenced To P M F Hydrograph Time From The Beginning of P M F Event.
4 th. ROAD CROSSING MILE 2.28
P M F PEAK FAILURE ELEV. 510.22
P M F PEAK FAILURE FLOW 19,423
ARRIVAL TIME 6.50 HOUR
PEAK FLOOD FAILURE TIME 17.625 HOUR
HYDRAULIC & WATER RESOURCES ENGINEERS, INC.
1345 Main Street
Waltham, MA 02154
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
New England Division
Waltham, MA 02154
WEATHERHEAD HOLLOW POND DAM, GUILFORD, VT
DAM BREAK ANALYSIS
INUNDATION PLAN "P M F"
SCALE: 1 IN = 800 FT
PLATE 3B



Flow Hydrograph at Ø mi
Maximum Flow 2314 cfs at 1.0 hrs
Discharge (cfs x 1000)
25
2
15
1
Ø5
Ø
Ø
1
2
3
4
5
Time (hr)
Discharge

Plate 4A

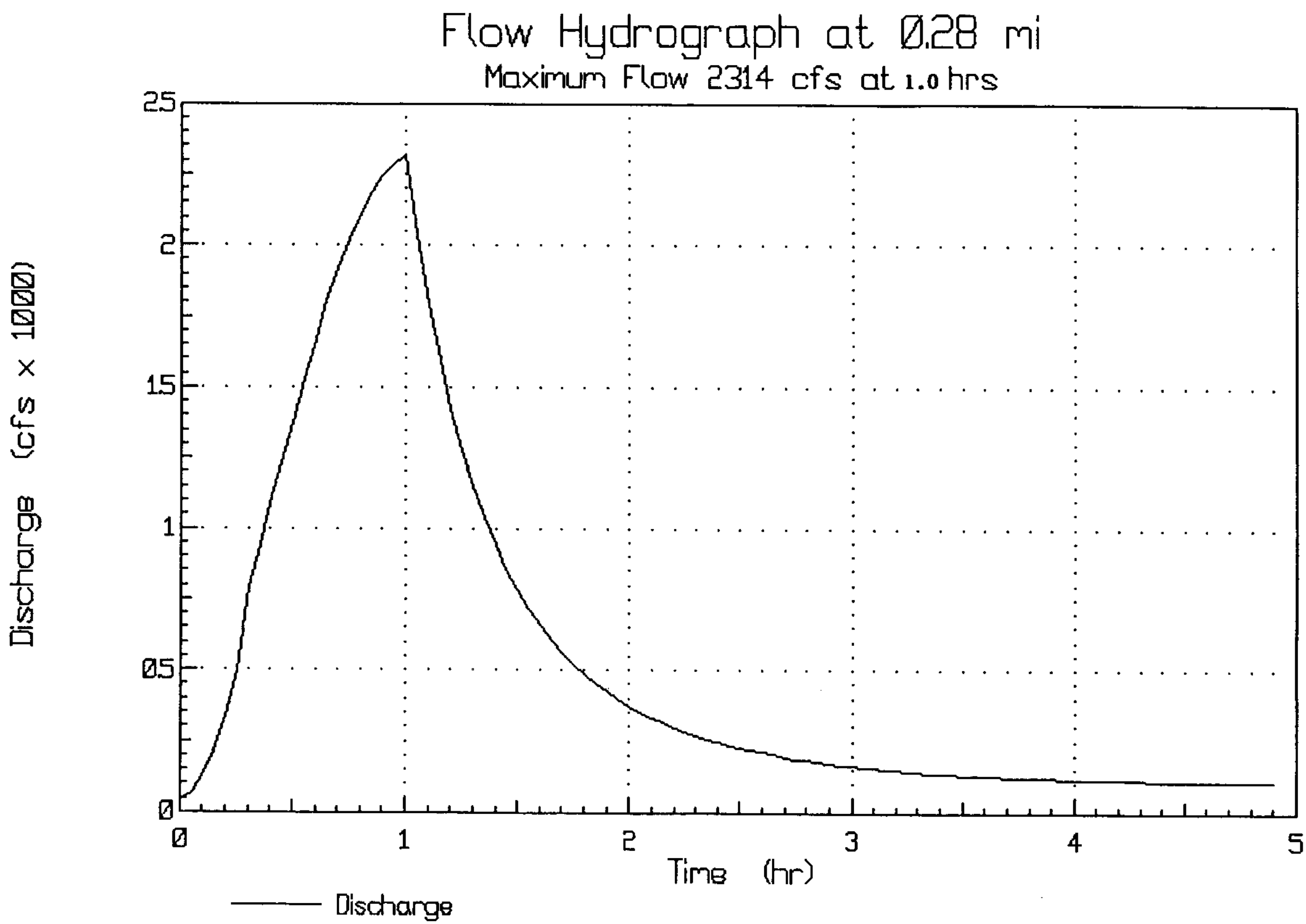


Plate 4A (cont.)

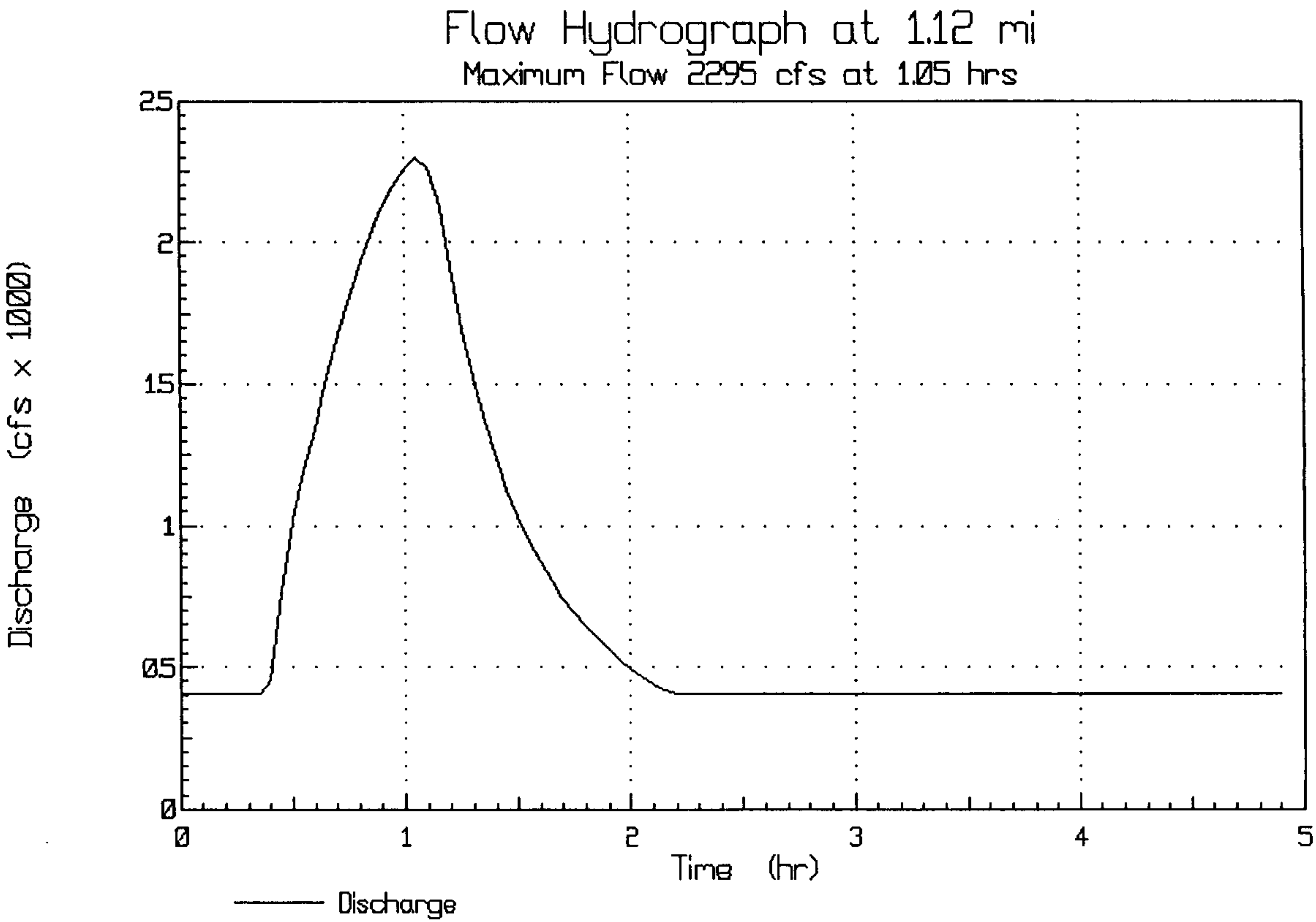


Plate 4A (cont.)

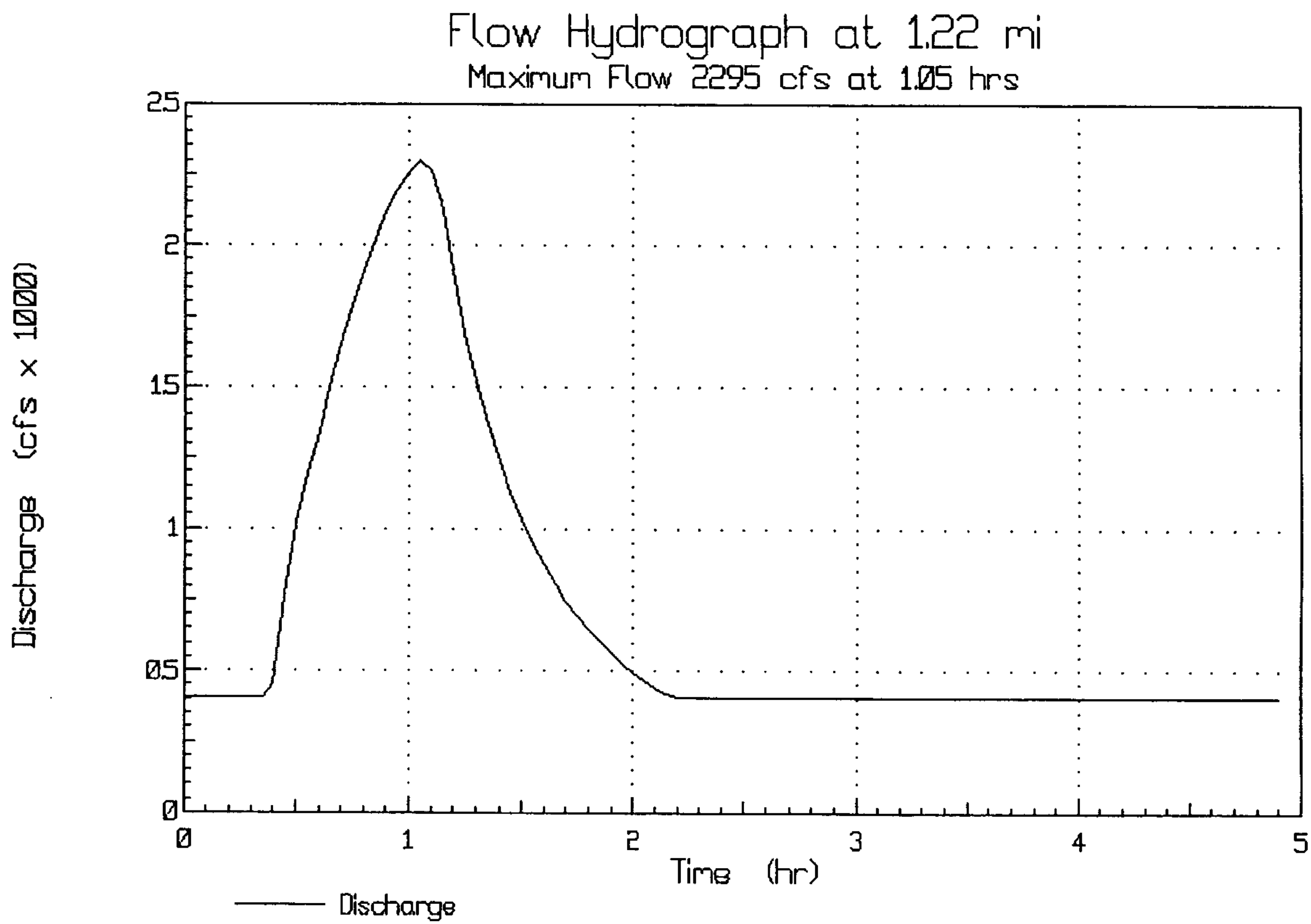


Plate 4A (cont.)

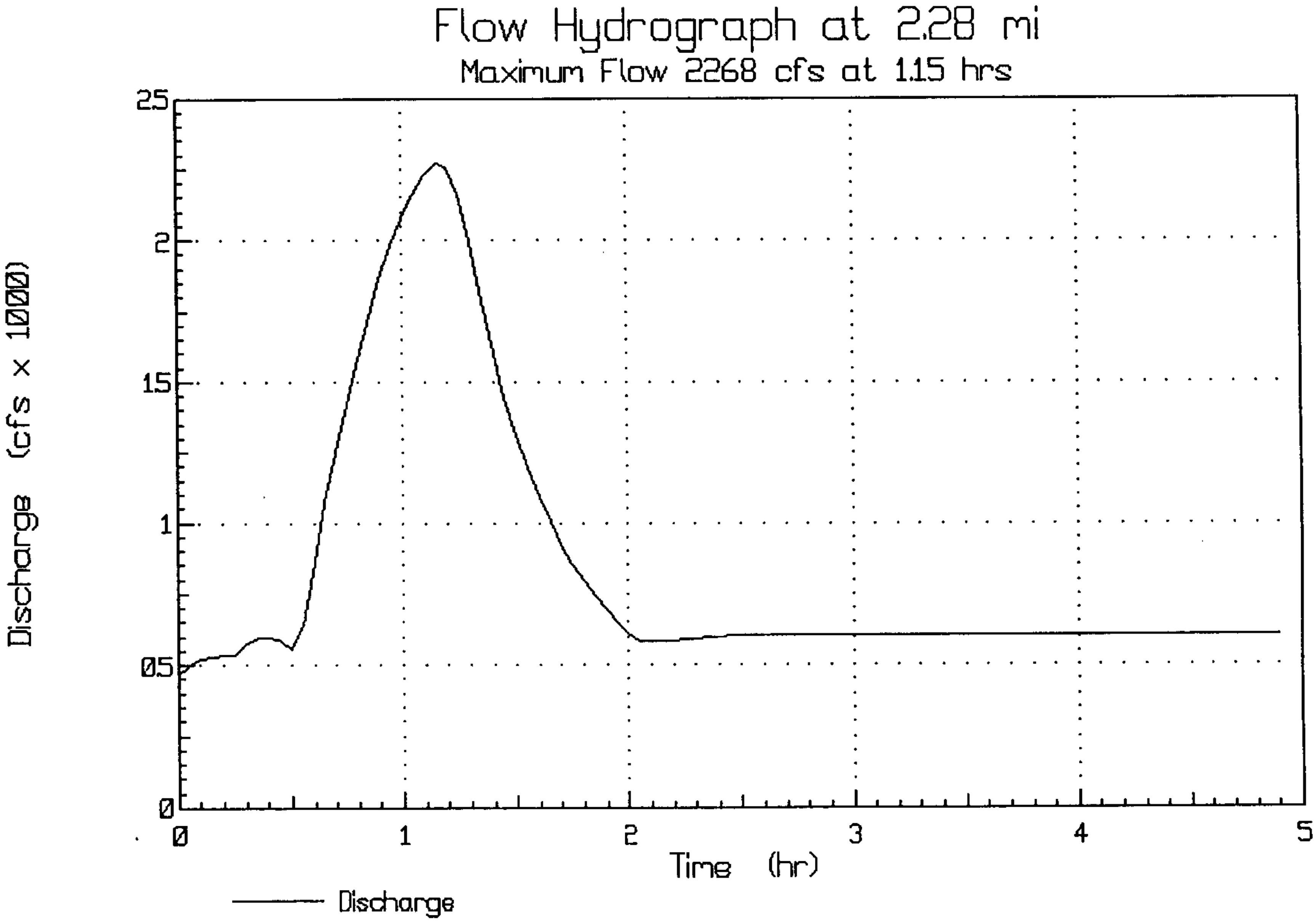
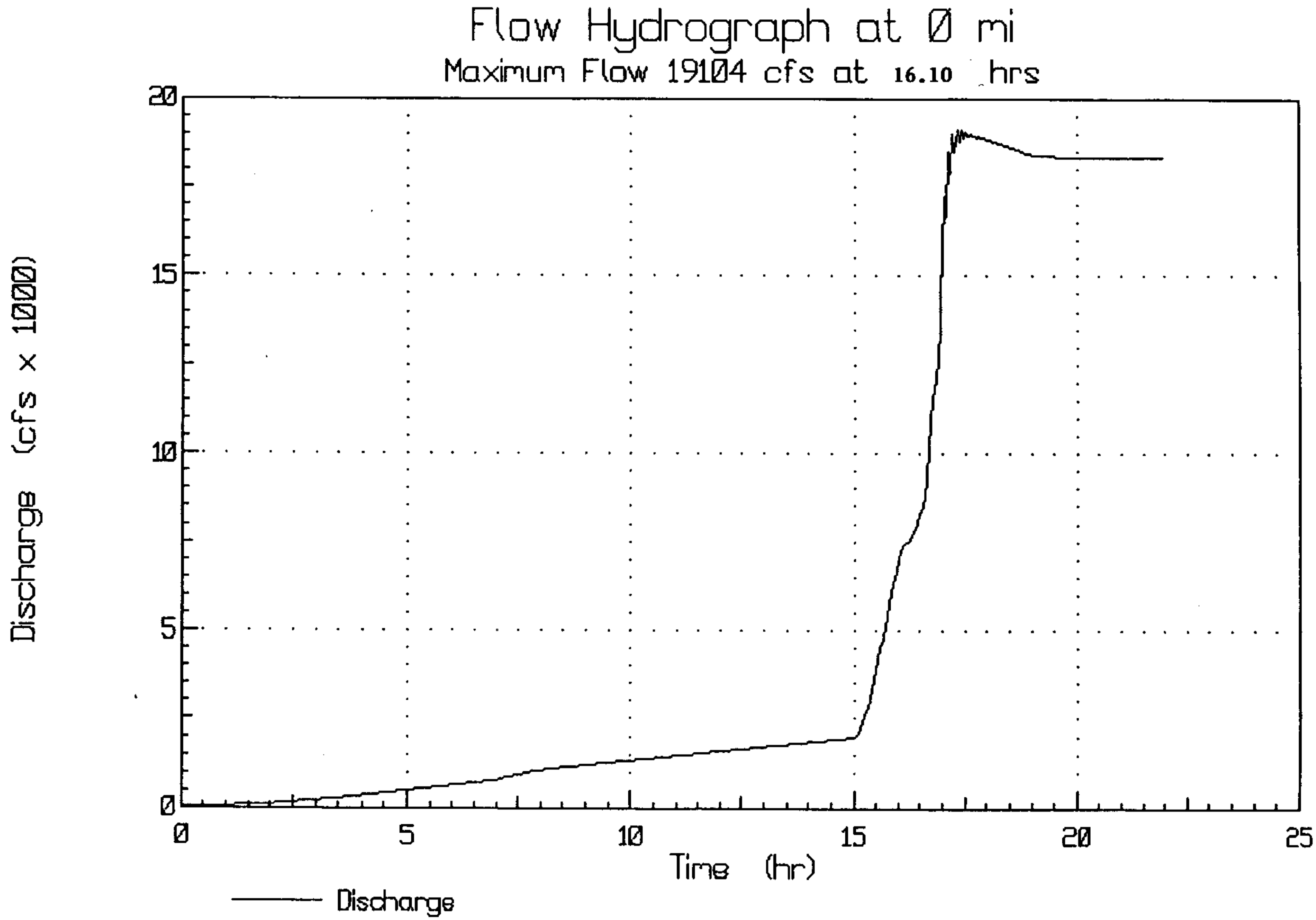


Plate 4A (cont.)



Flow Hydrograph at 0 mi
Maximum Flow 19104 cfs at 16.10 hrs
Discharge (cfs x 1000)
0
5
10
15
20
0
5
10
15
20
25
Time (hr)
Discharge

Plate 4B

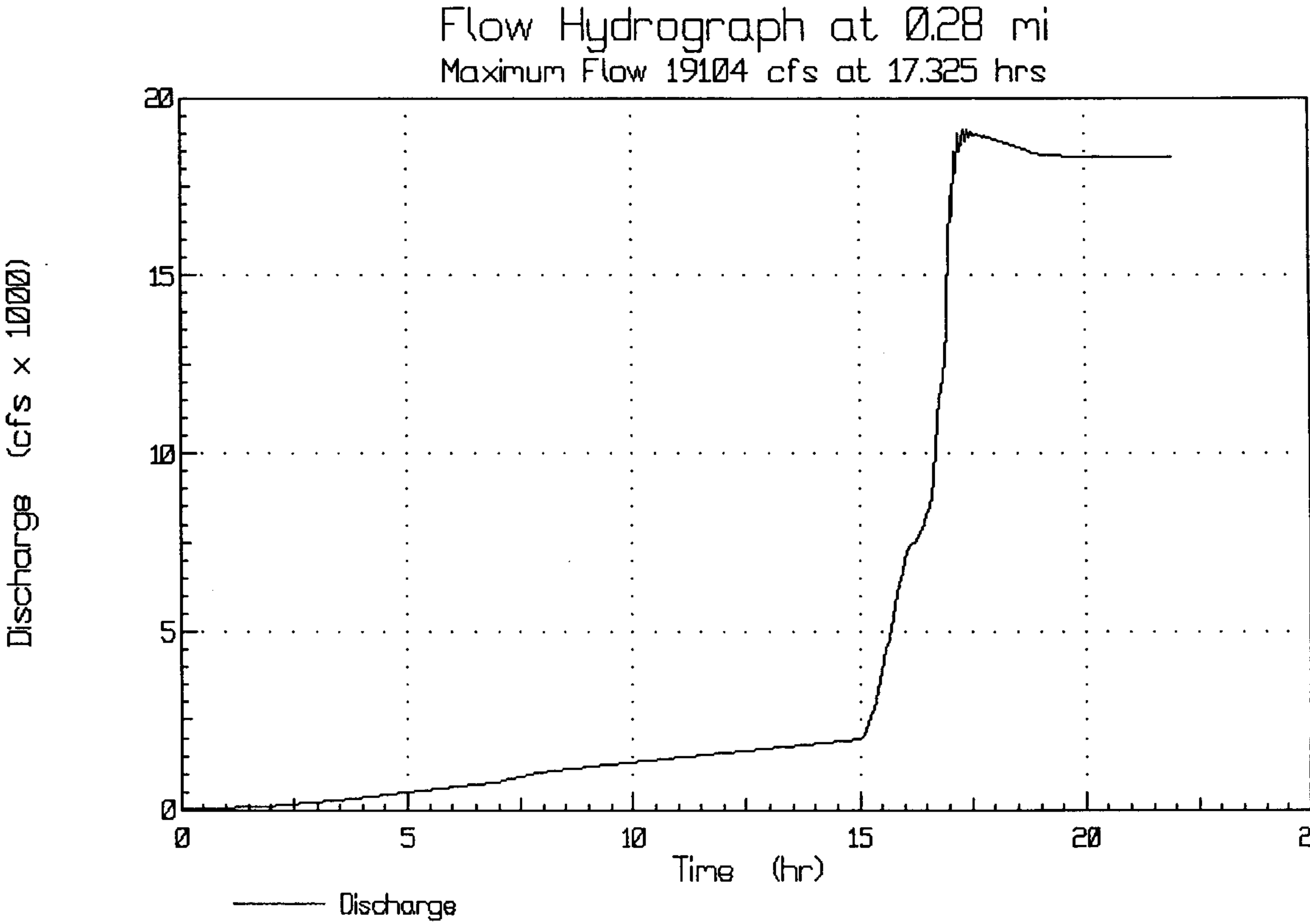


Plate 4B (cont.)

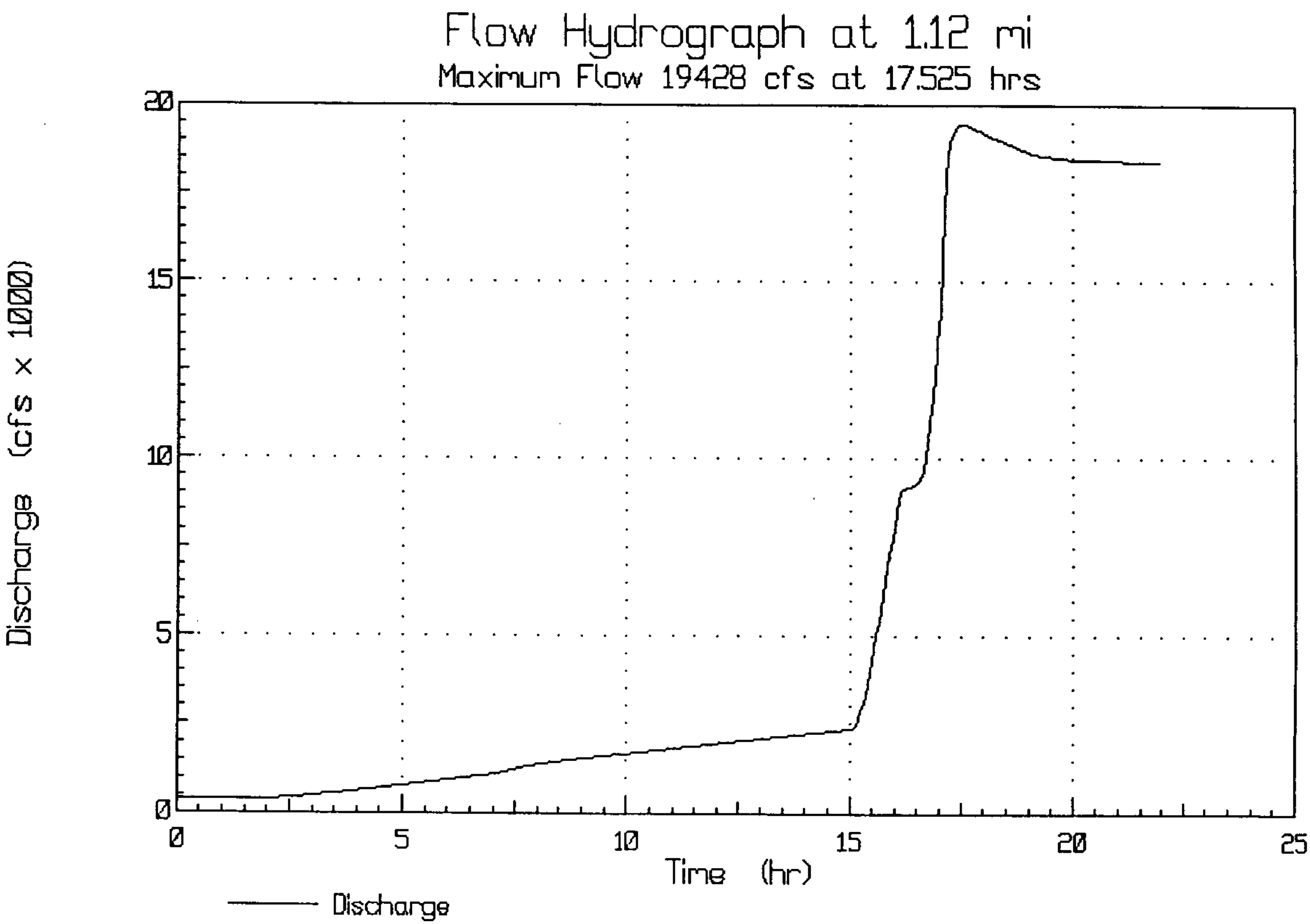


Plate 4B (cont.)

Flow Hydrograph at 1.22 mi

Maximum Flow 19428 cfs at 17.525 hrs

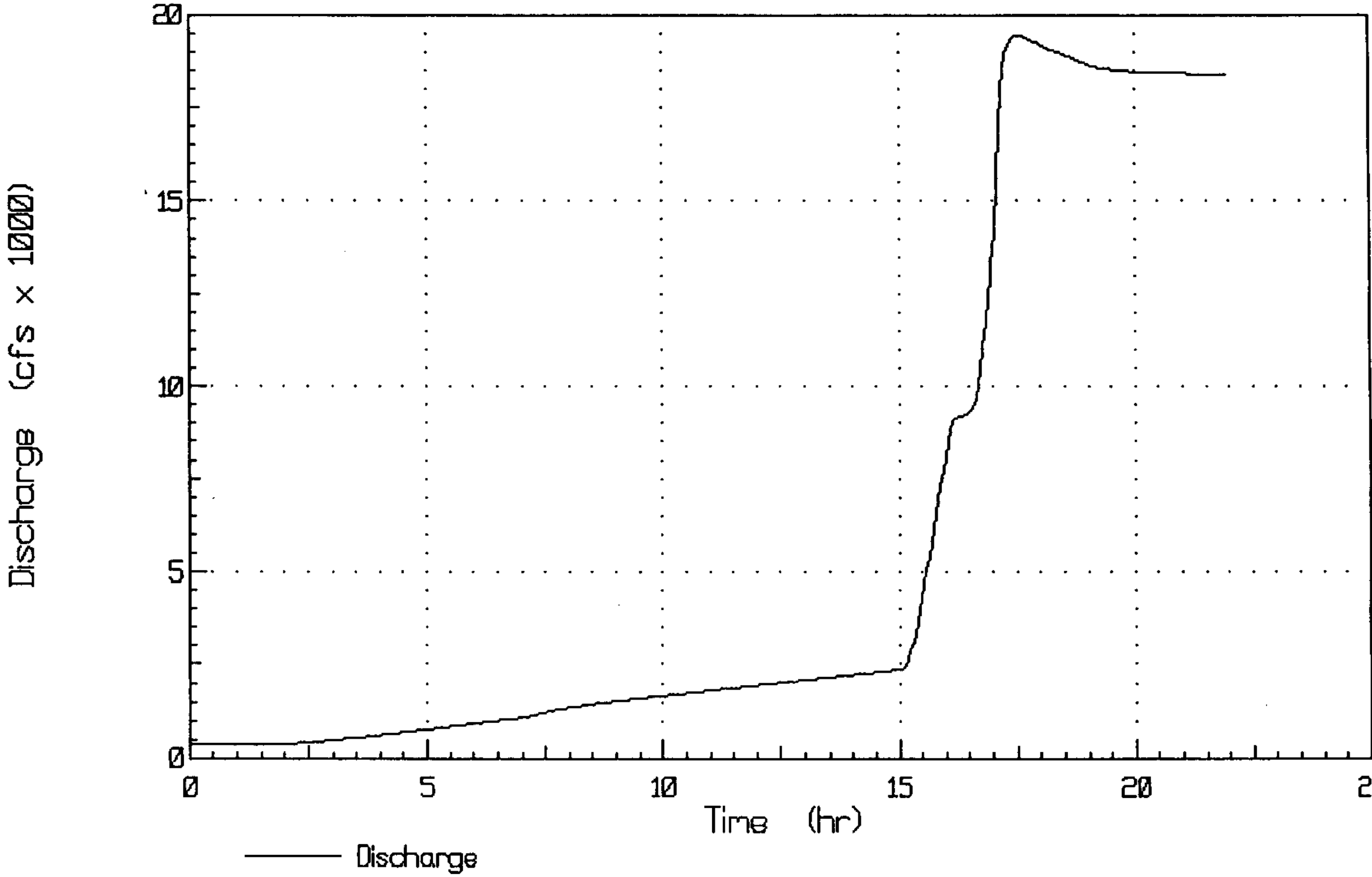


Plate 4B (cont.)

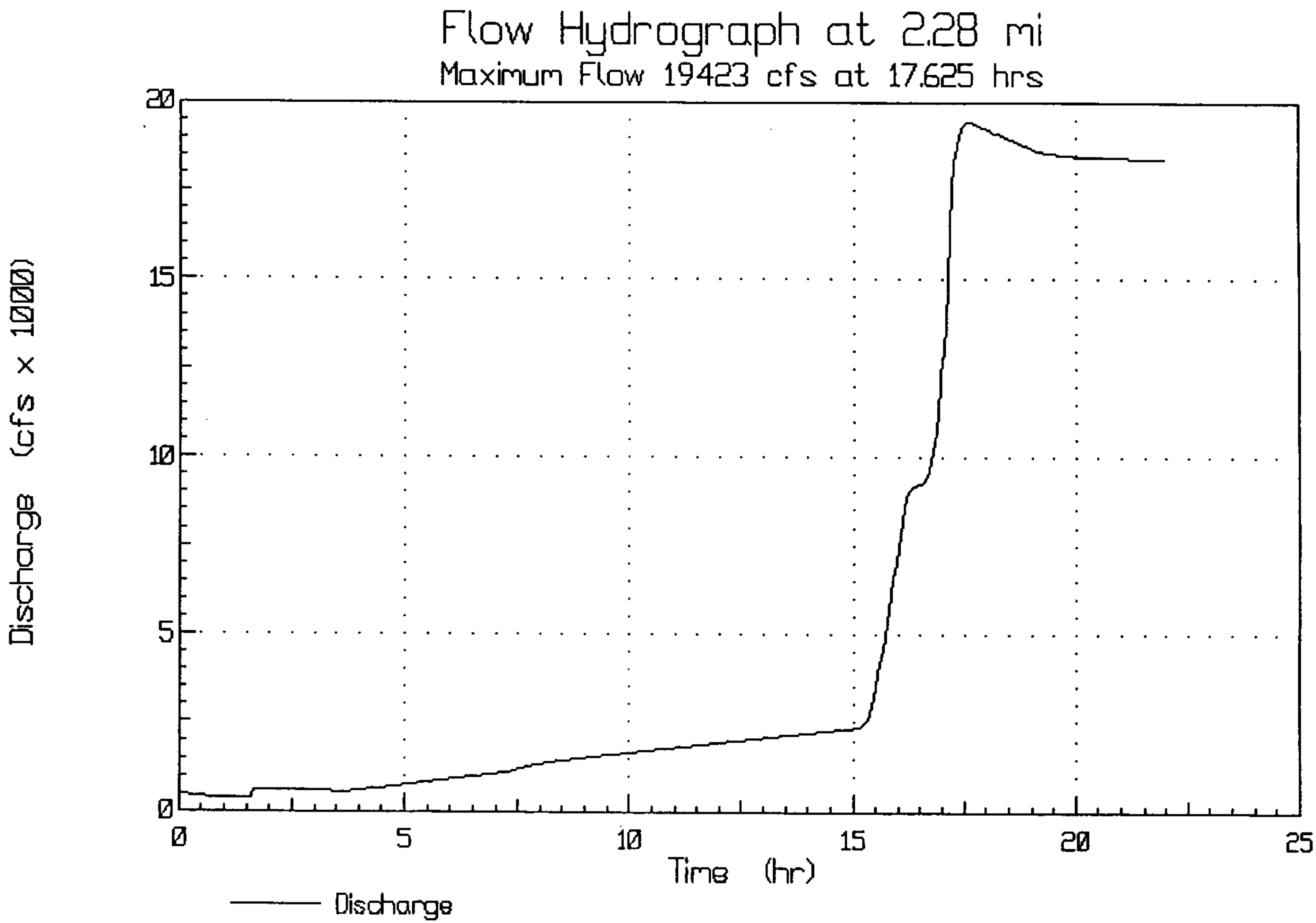


Plate 4B (cont.)

Flood Crest Profile "SUNNY DAY"

Water Surface Profile

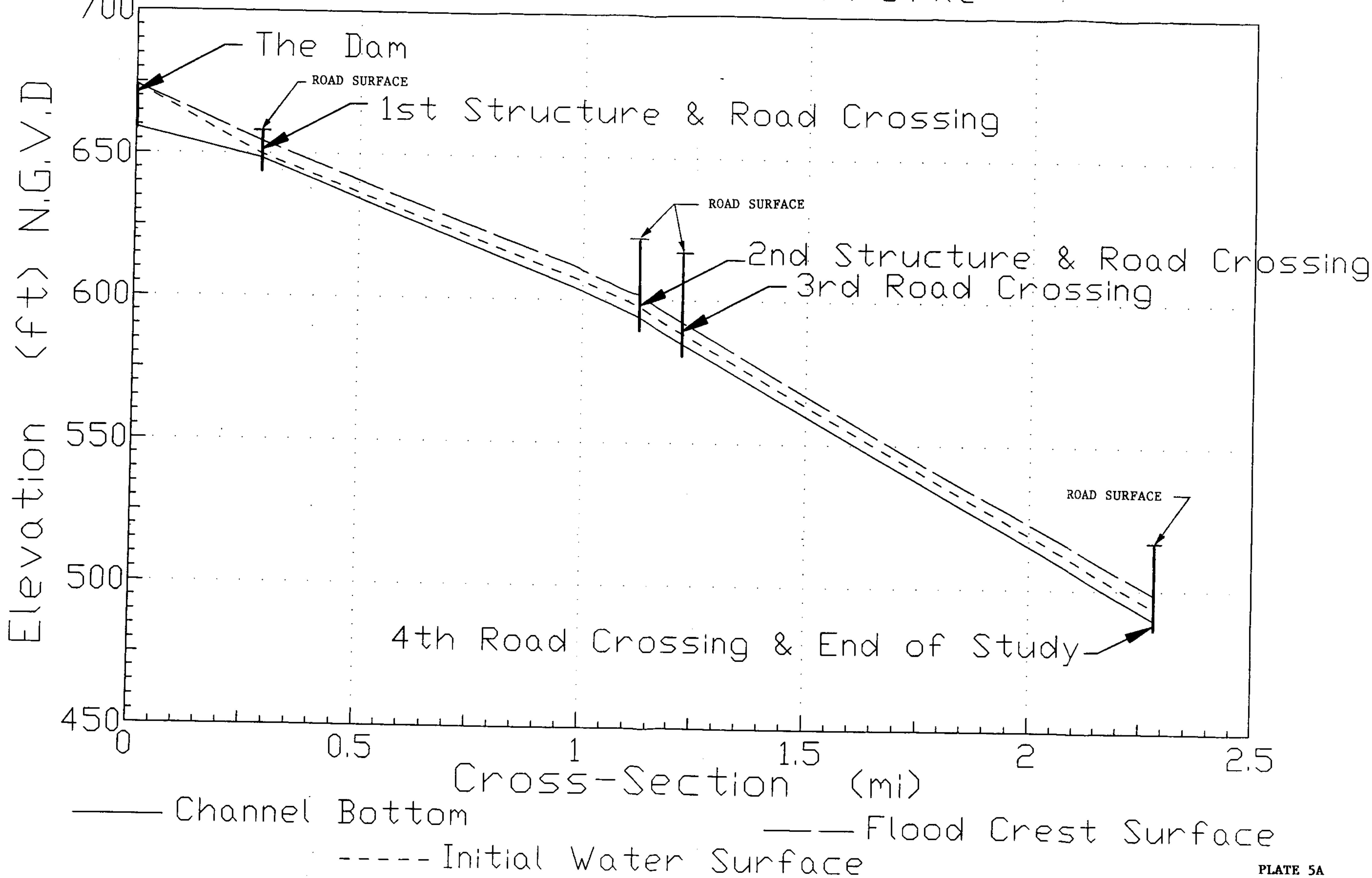


PLATE 5A

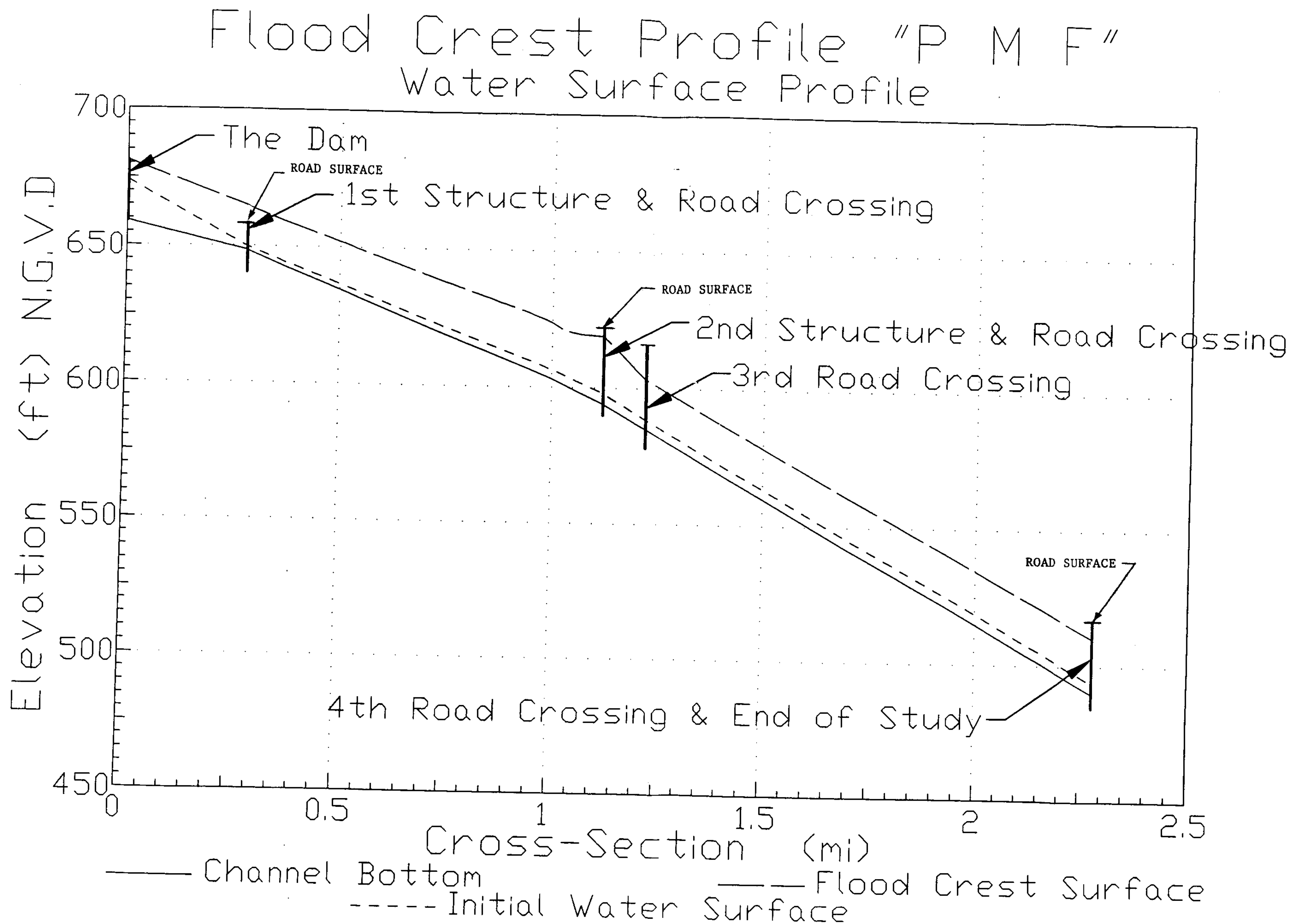

Flood Crest Profile "P M F"
Water Surface Profile
The Dam
ROAD SURFACE
1st Structure & Road Crossing
ROAD SURFACE
2nd Structure & Road Crossing
3rd Road Crossing
ROAD SURFACE
4th Road Crossing & End of Study
Elevation (ft) N.G.V.D
700
650
600
550
500
450
0
0.5
1
1.5
2
2.5
Cross-Section (mi)
Channel Bottom
Flood Crest Surface
Initial Water Surface

PLATE 5B

WEATHERHEAD HOLLOW POND DAM

100 YEAR INFLOW & ROUTED OUTFLOW HYDROGRAPH

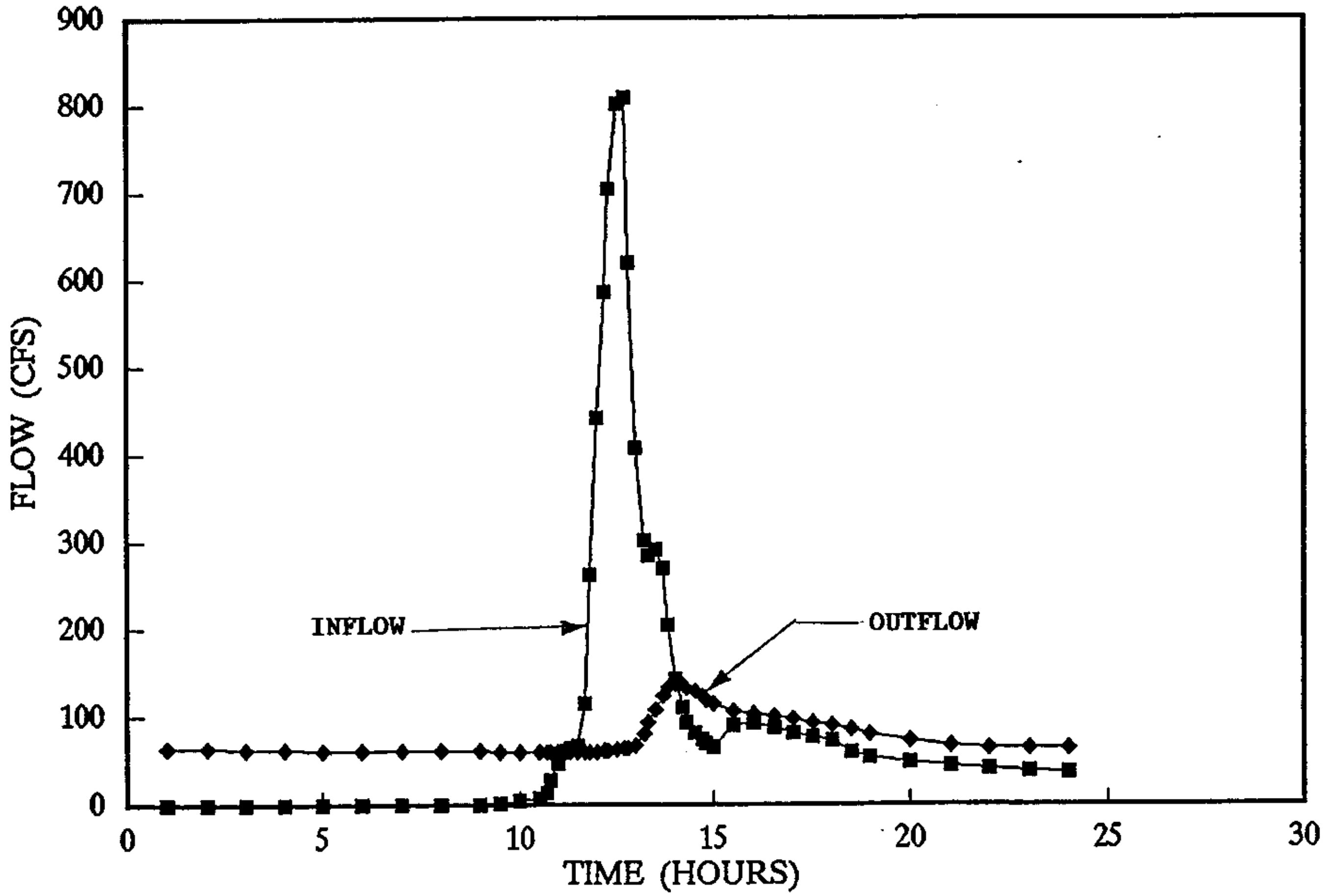


FIGURE 1

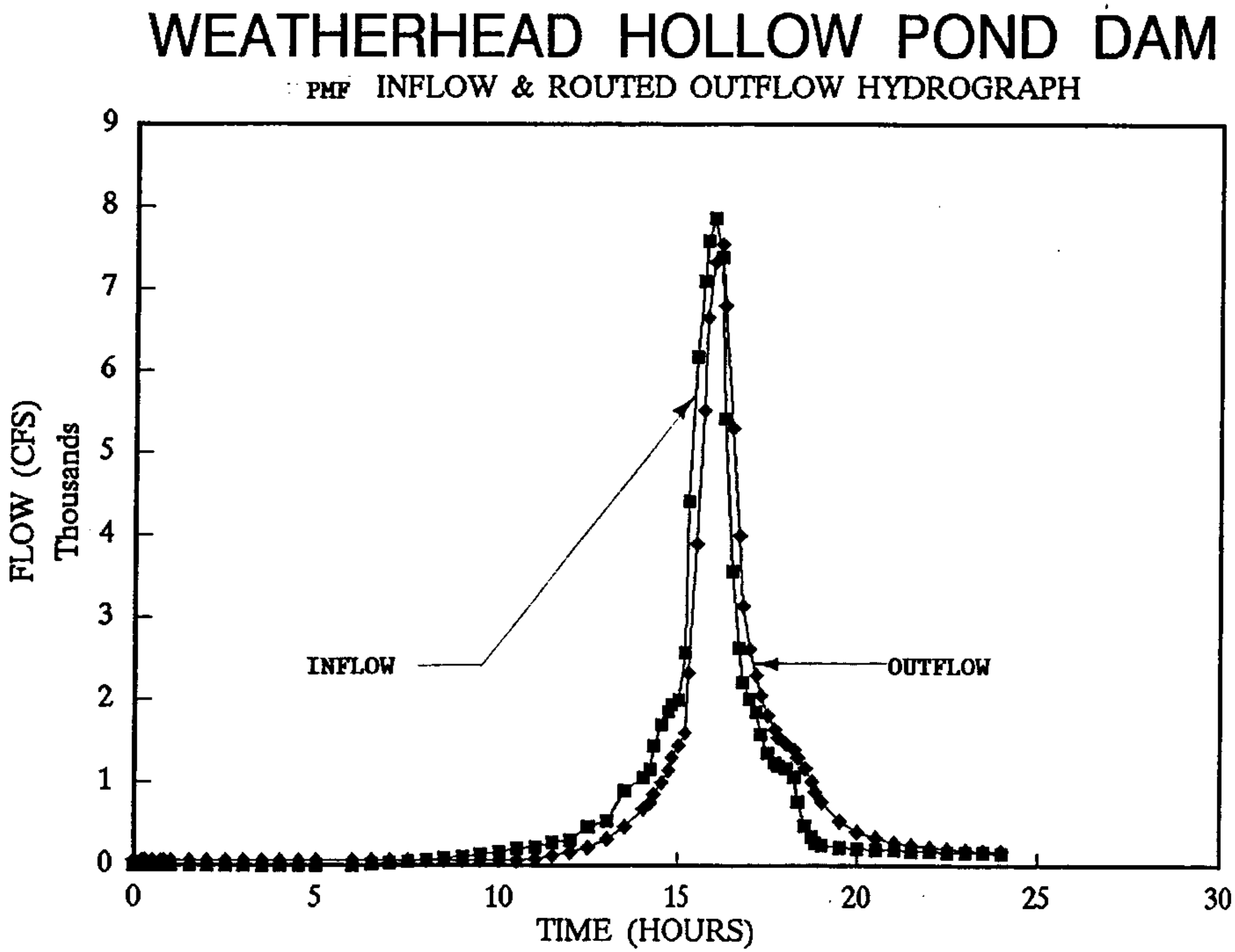

WEATHERHEAD HOLLOW POND DAM
PMF INFLOW & ROUTED OUTFLOW HYDROGRAPH
FLOW (CFS)
Thousands
TIME (HOURS)
INFLOW
OUTFLOW
0
1
2
3
4
5
6
7
8
9
0
5
10
15
20
25
30

FIGURE 2.0

WEATHERHEAD HOLLOW POND DAM

0.75 P M F OUTFLOW HYDROGRAPH

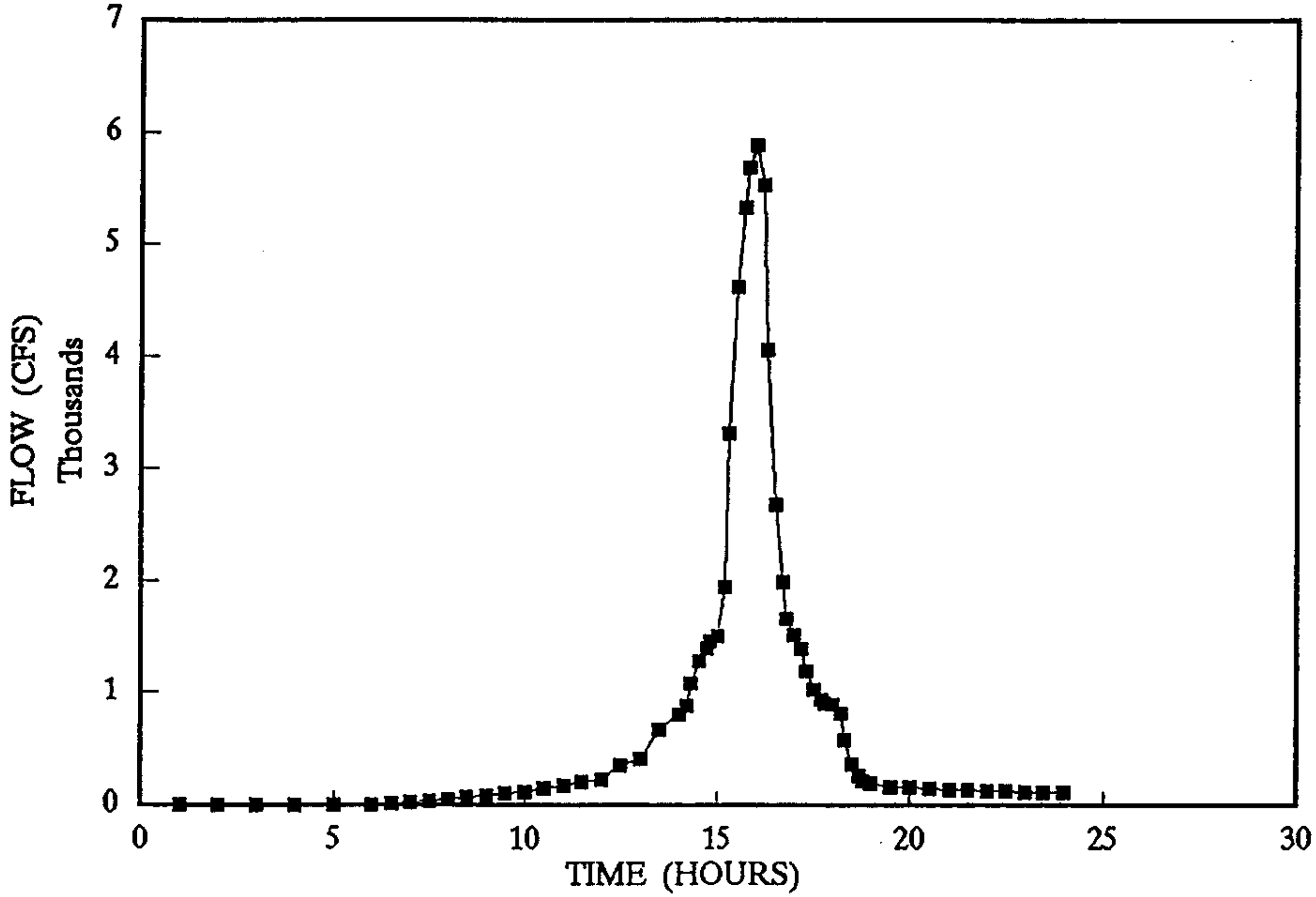


FIGURE 2.1

WEATHERHEAD HOLLOW POND DAM

0.50 P M F OUTFLOW HYDROGRAPH

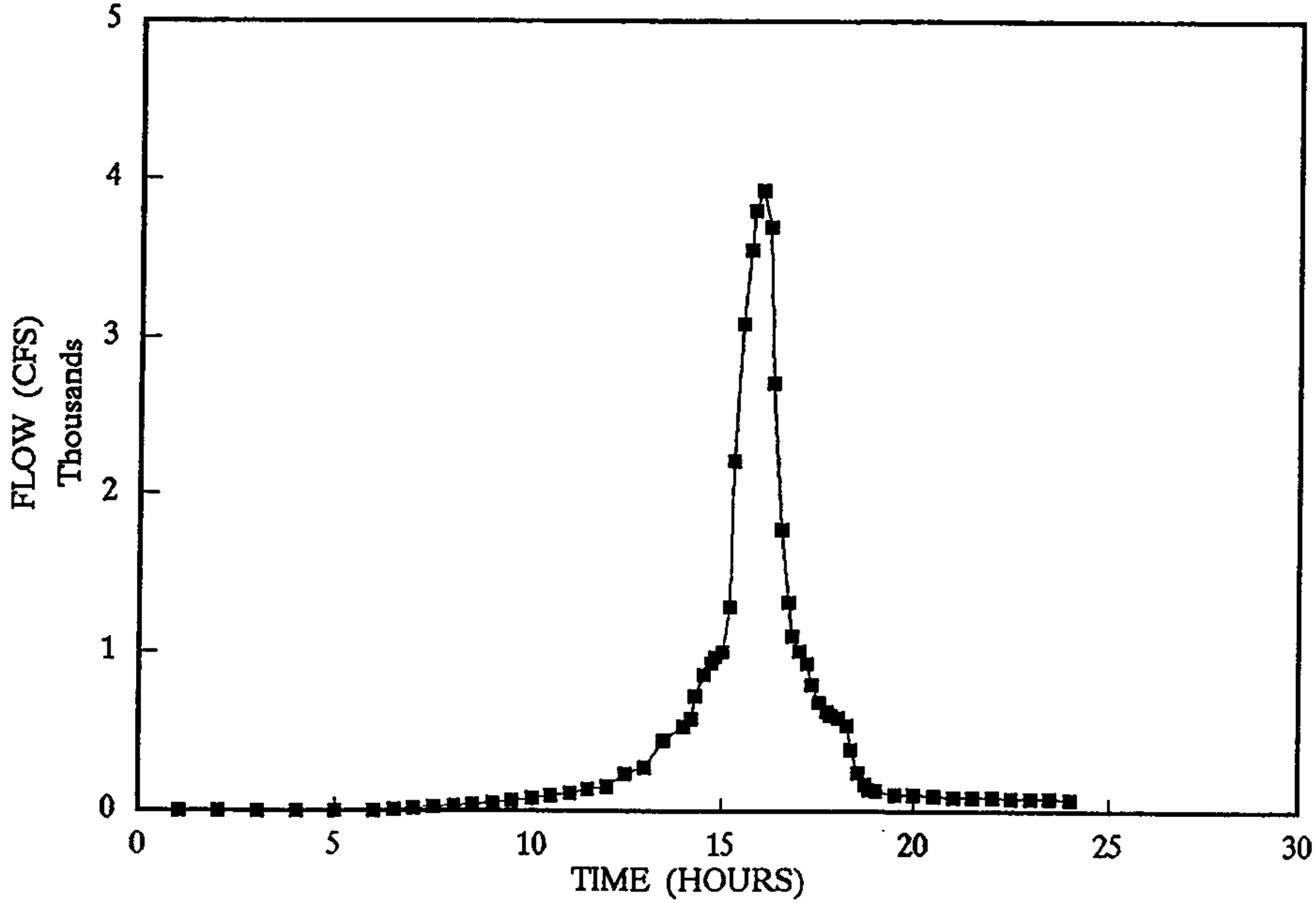


FIGURE 2.2

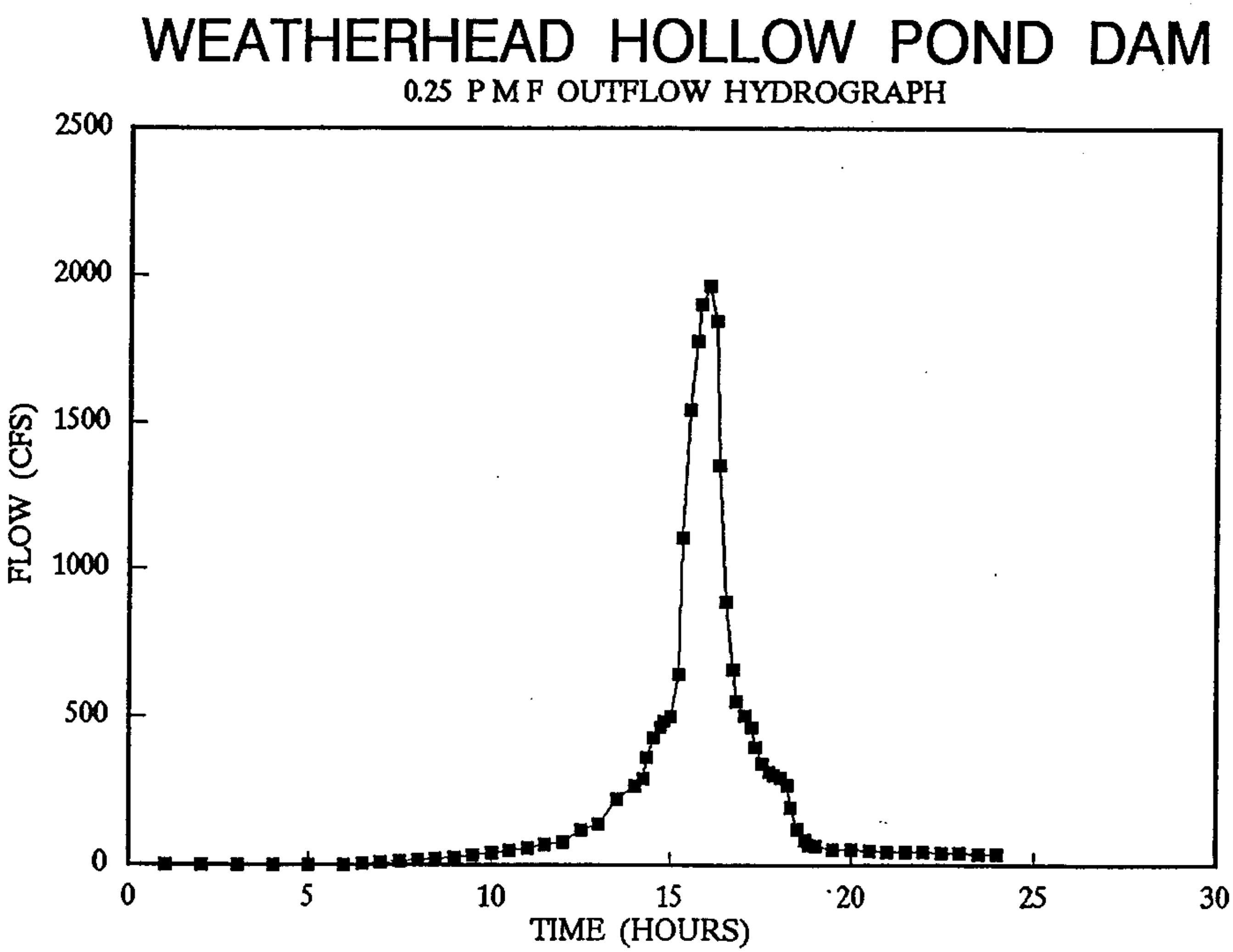

WEATHERHEAD HOLLOW POND DAM
0.25 P M F OUTFLOW HYDROGRAPH
FLOW (CFS)
2500
2000
1500
1000
500
0
0
5
10
15
20
25
30
TIME (HOURS)

FIGURE 2.3

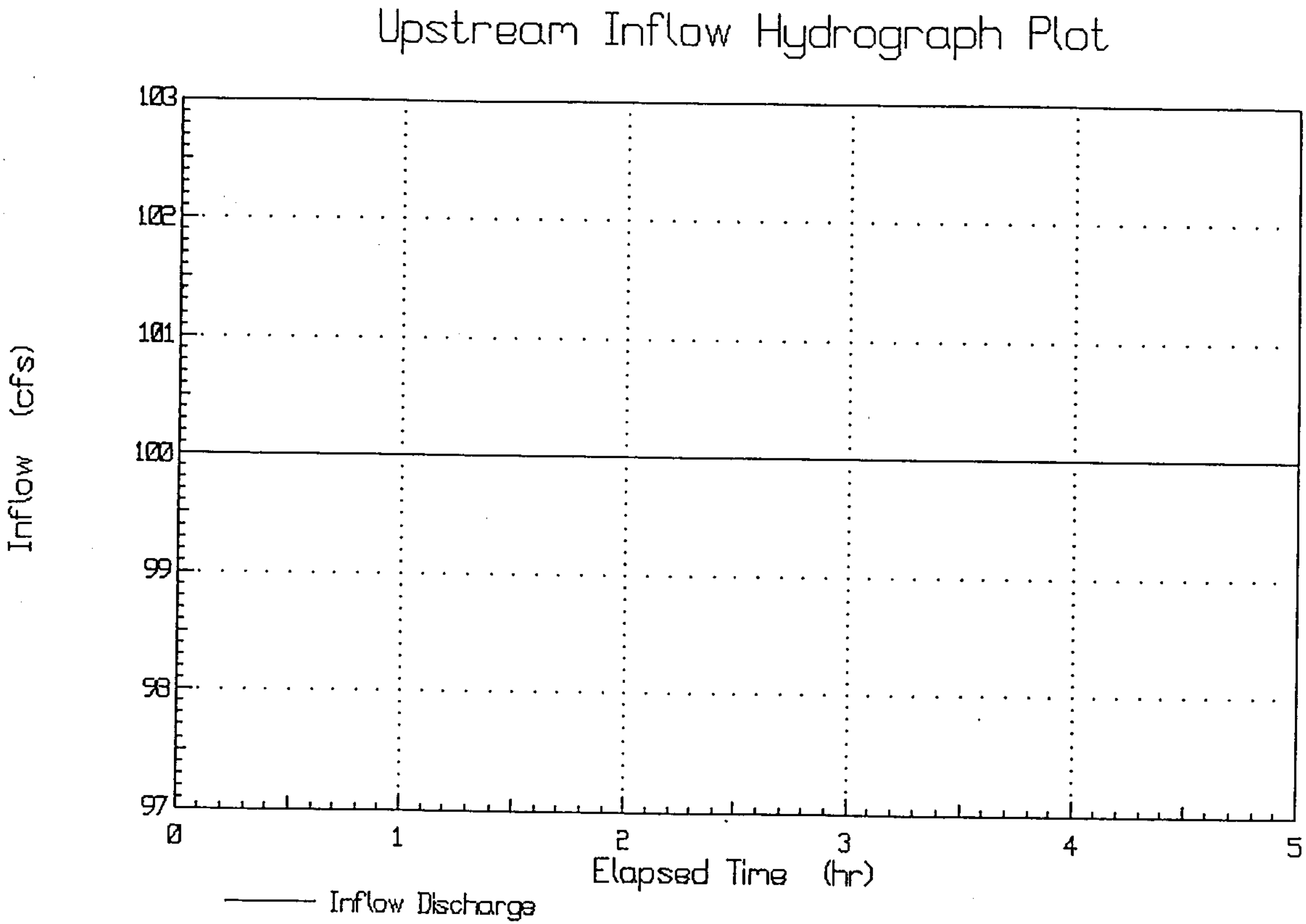


FIGURE 3
SUNNY DAY INFLOW HYDROGRAPH

B. EMERGENCY ACTION PLAN

1. INTRODUCTION

The Emergency Action Plan (EAP) is a suggested procedural outline (Ref. 12) indicating appropriate steps to be taken in the event of an impending failure of the Weatherhead Hollow Pond Dam. Also, this EAP lists phone numbers of certain local and state officials to contact in case of an emergency.

2. ITEMS IN THE EAP

The following are major items which should be addressed by the owner of the dam:

- Monitoring
- Evaluation
- Preventive Action
- Warning

3. MONITORING

a. Purpose

Having a person monitor the dam in the event of an impending dam failure is the first step in implementing the EAP. During periods of heavy precipitation, flooding or any unusual hydrologic events that might cause structural damage to the dam, the owner should have qualified personnel monitor the dam. The owner should assume responsibility for having the monitor at the dam within a reasonable time and for providing an adequate communication system between monitor and local officials.

b. Designated Owner Contact

Name:	Mr. Angelo Incerpi Director of Operations Department of Fish & Wildlife	
Phone:	Home:	(802) 684-3809
	Work:	(802) 241-3700

c. Training

The owner should provide proper training such that the monitor will have sufficient ability to recognize the condition of the dam and be able to identify and evaluate specific problem areas. This training should be extensive enough to allow the monitor to describe condition to local officials.

d. Communication System

The owner should provide primary and secondary communications systems between the dam monitor and local officials.

Primary System:	Normal telephone communication. The monitor should have access to the nearest available telephone and should have on his person the telephone numbers of all appropriate local officials.
Secondary System:	Shortwave radio: If the phone system is out of service, the monitor should have access to a shortwave radio that can be monitored by local officials with scanners.

As an alternative to this system, if any local officials live within a short distance of the dam, the monitor could drive to one of their residence if the roads are passable.

4. EVALUATION

a. Purpose

In conjunction with the ability to assess the condition of the dam, the monitor should have the ability to determine and evaluate the nature of any existing problem. This evaluation is a crucial step, because failure to accurately and promptly identify problem may adversely affect the EAP warning system.

b. Checklist items

Following is a check list of items that the monitor should use for assistance in preparing a safety assessment of the dam.

(1) Water Surface Level

Elevation:

a) Normal
b) High (if So, how high, with respect to the top of dam?)

(2) Principal Spillway

Condition upon arrival:

a) Clear
b) Blocked (if so, to what extent?)

(3) Emergency Spillway

Condition upon arrival:

a) Clear
b) Blocked (if so, to what extent)

(4) Top of Dam

a) Cover
b) Erosion

(5) Downstream Face

a) Cover
b) Erosion
c) Evidence of piping

5. PREVENTIVE ACTION

The monitor should ensure that the principal and emergency spillways are kept clear of debris during normal conditions. In the event of flood conditions, the monitor should also take reasonable steps to ensure that the spillways do not become blocked with debris so that they can carry their full capacity. The monitor's safety should not be jeopardized.

6. WARNING

a. Purpose

If the monitor feels that possible failure of the Weatherhead Hollow Pond Dam is imminent, he should immediately notify the designated parties by utilizing previously established communication systems. The monitor should notify the following officials and the downstream residents. Others can be contacted if determined necessary by the monitor.

b. Notification Chart (As of April 1993)

(1) Mr. Barbarn B. Olis
Town Clerk
Home: (802) 257-1420
Work: (802) 254-6857

(2) Mr. Thomas Porter
Chairman - Board of Selectmen
Home: (802) 257-0122
Work: (802) 257-0848

(3) Mr. Lyndon M. Svuires
Constable
Home: (802) 254-2267

(4) Mr. Bernard LaRock
Fire Chief
Town of Guilford
Home: (802) 254-9738

(5) Mr. Michael Dusavitch
Civil Defense
Town of Guilford
Home: (802) 254-2459

(6) Vermont Emergency Management Agency
24 Hour Duty Officer
1-800-422-8606
(802) 244-8721

(7) Department of Fish & Wildlife
Owner of Dam
Waterbury, Vermont

Official at the Vermont Emergency Management Office can be reached (24) hours a day. During normal business hours, the receptionist at the office will locate the current duty officer. During all other hours the phone connects to the Vermont State Police Department in Guilford, Vermont, which will locate the duty officer. In the event that the phone system has failed, any Vermont State Police barracks or cruiser can reach the duty officer through its radio system. Any available shortwave radio or CB radio could be utilized to contact the nearest police barracks.

c. Downstream Residents

(To be filled out and periodically updated by Dam owner)

Name	Phone Number

C. REFERENCES

1. Recommended Guidelines for Safety Inspection of Dams, U.S. Dept. of Army, Office of the Chief of Engineers, Washington, D.C., Sept. 1979.

2. U.S. Weather Bureau Rainfall Frequency Atlas of the United States, May 1961, Technical Paper 40.

3. Hydrometeorological Report 51, the U.S. Weather Bureau Probable Maximum Precipitation Estimates, June 1978.

4. Hydrometoerological Report 52, the U.S. Weather Bureau Application of Probable Maximum Precipitation Estimates, August 1982.

5. HEC-1, Flood Hydrograph Package, User's Manual, September 1990.

6. DAMBRK, the NWS Dam-Break Flood Forecasting Model, Users Manual, November 1981.

7. Corps of Engineers Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations.

8. Guide for Selecting Manning's Roughness Corfficients for Natural Channels and Flood Plains. USGS Water-Supply Paper 2339, 1989.